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GENERAL ELECTRIC REPORT.

That the annual report, just issued, of the General Electric Company would reflect the general prosperity prevailing during the past year was to be expected. A reading of the report, a condensation of which appears elsewhere in this issue, shows such an expectation more than realized. Aside from the satisfaction which the report will naturally give to those directly interested in the General Electric Company, financially or otherwise, it also cannot but gratify the many others who will see in the fine showing of such a great factor in the electrical field, a sure indication of the strength and powerful onward march of the industry represented. An admirable feature of the report—as of previous General Electric reports—is the full and frank analysis of the different items. In this respect an example is set which, if followed by other so-called industries, would relieve much of the present suspicion in which their securities are generally held.

The figure of overwhelming significance to the general electrical public is that of total sales, amounting, in round numbers, to $22,380,000, an increase of $6,700,000 over last year, and representing a net profit of $3,805,000, an increase of $1,221,000 over 1898. During the period of General Electric's tribulations, one of the most unfavorably viewed items in its assets was that of securities carried of electric lighting and railway companies. How different a view may now be taken of this item is evident from the statement that during the year the profit on sales of some of these securities on basis of the value at which they were carried as assets, was no less than $838,857, and that this asset returned $309,428 in dividends and interest. Another significant feature of the report is the reduction of the item of patents, franchises and good-will, by $2,000,000; moreover, the item for patents and patent expenses for the year covered, amounting to $353,333, is also written off 4½ per cent. dividends were paid, and yet the surplus has been increased from $156,570 to $2,353,030.

As to the future, the indications of the report are no less favorable than its summations for the year covered. Large extensions made to the Schenectady, Lynn and Harrison works are reported to be crowded with work at present, and further extensions are under way. The total expenditures for new buildings, extensions and machinery equipment for the past year to meet increased business, amounted to $900,000. As to engineering details, the reports of vice-presidents Griffin and Rice, refer to the change now taking place in electrical apparatus, due, largely to the policy of consolidating small lighting and railway companies and substituting one large generating plant for two or more small ones. As examples of large work are the 5000-hp generators supplied to the Metropolitan Traction Company, and eight machines of the same general character now being made for the new electric lighting station of New York, while during the year the orders for the revolving field type of alternating current generator with stationary armature amounted to over 200,000 horse-power, and 150,000 horse-power of large transformer, of the air blast type, were made. Another note of engineering interest is the reference to a marked increase in the demand for electrical apparatus of special design which, naturally, is deprecated

in the report, as diminishing the effective output of the works. To meet this condition, however, the report states the lines of standards are being systematically increased.

Central Station Economy.

The article by Prof. William D. Marks, printed elsewhere in this issue, sets forth a simple system for determining the cost and proper selling price of electricity, the value of which method is enhanced by the fact that it rests upon practical knowledge obtained in a comprehensive experience in central station management. The several factors in the simple equation given for fixing the selling price of current are of a kind that ordinarily can be readily determined by the intelligent central station manager. The three requiring exercise of judgment are those referring to fixed annual charges per lamp, variable hourly charges per lamp and the annual number of hours burned per lamp. The criterion for the former is that those charges are fixed which would go on if the fully equipped and manned station were stopped for a short period. The variable charges are those often classified as operating expenses, and the remaining factor—the average annual hours burned per lamp—is one which can be quite exactly known, particularly where station output wattmeters are employed. It will be noted that account is not taken in the prices thus deduced of the profitability of different classes of service, but these could be fixed by separate deductions from the average prices which the formula gives. In view of the favorable experience in central station work with storage batteries in this country and abroad, we doubt if many will consider that the storage battery question can properly be dismissed as summarily as is done by Prof. Marks, and the same remark applies to the subject of the maximum demand system of charge.

From the article it would appear that Prof Mark's pessimistic views concerning the financial management of central stations under private ownership are based upon stock-jobbing abuses alone, for no intimation is given that he believes that the operation of such plants would be more economical if under management dominated by the "political pull" to which he refers in connection with the granting of franchises. The abuses to which Prof. Marks refers would appear to be of a kind that can be very simply met by legislation, and in fact have been so met in Massachusetts. Moreover, during the past several years central station men have appeared to tend toward the opinion that it is to their interest to have proper governmental supervision over their affairs such as is exercised in the State named. The result of publication of accounts and the check on stock watering thereby afforded would undoubtedly take away many of the arguments now advanced in favor of municipal plants.

Interference Between Street Railways and Submarine Telegraph Cables.

There is war in South Africa between the British and the Boers. There is also war in that distracted land between the Telegraph Cable Company and the Traction Company at Capetown. The latter war is connected with the ownership of the earth at Capetown and its vicinity, and damages have been sought in the English courts by the cable owners from the car owners, for spoiling their signals and sullying the purity of their ground-return circuit. The signals received at Capetown on the siphon-recorder have been the organic signals of the Morse alphabet as forwarded in *secundum artem* by the operator at far away Mossamedes, together with incoherent kicks and jerks of the siphon occuring each time an electric car started in Cape Town after picking up a passenger. The cable operators greatly objected to this wide-spread effusiveness of joy on the part of the traction company every time a soul was saved for the car system, and begged the traction company to take steps to smother their complacency and desist from "putting their oar into the stream of electric news current that trickled into the cable office along the West African shore.

Professor Jamieson recently investigated the nature of the interference, and read a paper on the subject in Scotland. The means recommended for obviating the cable disturbance was a bursted turn-wire or two-wire cable, double-armored, for the shore end instead of the existing single-wire single-armored cable. This means making a cable earth several miles out at sea, and bringing in the circuit in telephone fashion from that point. All electrostatic and electromagnetic disturbances on the cable would thereby be eliminated, and unless the traction company could appreciably alter the potential of the sea at the distant earth, they would fail to effect the cable signals.

Great difference of opinion among electricians has been elicited in the discussion of this paper as to the cause of the disturbance A siphon recorder has a sensitive organization, and responds very visibly to disturbances of a few microamperes in amplitude, so that with hundreds of amperes generously dispensed by a trolley station about a mile away from the cable office, and using ground return over a track system paralleling the cable for about a mile in length at half-mile distance, there was ample room for pyrotechnical electric display.

Some say that electromagnetic induction was the sinful source, and others that no electromagnetic induction can affect a conductor enclosed in a return conducting sheath. The latter proposition would be true if all the return current returned evenly distributed within and solely confined to said sheath. Others say the disturbance is due to the inclusion of suddenly generated potential differences in the cable return circuit, and no consensus of opinion appears to have been reached. It is stated that the disturbance was greatly reduced by making cable earth through an auxiliary short cable reaching a few miles out to sea; and, for a time, this gave solace to the operators until the traction company took on more lines and increased its cars and currents, and then the separate cable earth was no longer a panacea. The moral of the tale seems to be that a twisted pair of conductors is the only salvation of a telegraph or telephone manager when the motorman invades his precincts and takes possession of the earth.

The Amplitude of Vibration in Telephone Diaphragms.

An interesting paper on some measurements of the amplitude of vibration in telephone receiver diaphragms was recently read before the British Physical Society. It is well known that a telephone receiver may be uttering strident tones and yet no vibratory movement of the diaphragm will be perceptible either to the touch or to the eye. In fact, some observers have gone so far as to declare that the telephone diaphragm never vibrates in the same sense that the tympanum of a bass drum vibrates, and that the vibratory movement in the telephone diaphragm is entirely molecular. Sensitive optical methods have, however, been tried at different times, which appeared to indicate that there was at least some bodily vibration of the disc.

In the measurements described in the paper, the method was purely mechanical, although checked by optical means. A screw of half-millimetre pitch, with a graduated head, was capable of adjustment to $\frac{1}{5000}$th of a turn. Such an angular unit represented, therefore, an advance of about four millionth of an inch ($\frac{1}{10000}$th millimetre$=\frac{\mu}{10}$ or one-tenth micron). The screw pressed upon a triple set of levers minifying jointly in the ratio $\frac{1}{100}$, so that the final

tip was advanced one twenty-fifth of a millionth of an inch ($1\mu\mu$) for the unit of angular screw motion. The tip was brought into play over the centre of a telephone diaphragm, and acted to the latter as a relay lever acts towards its contact stop. The screw was adjusted until a receiver in the circuit indicated that the tip was just touching the diaphragm. Measured currents of feeble intensity were then sent through the telephone, buckling the disk very slightly, and requiring a small advance of the screw and tip, to re-establish electric contact. By this means the amplitude of motion of the centre of the diaphragm corresponding to a series of measured steady currents was found and plotted in a curve. By measuring the virtual or effective strength of telephonic alternating currents, the amplitude of vibration corresponding to those currents was taken from the plotted curve. Audible sounds in the telephone corresponded to about $\frac{\mu\mu}{3}$ or 15 billionth of an inch. "Comfortable" sounds corresponded to about 50 $\mu\mu$ or 2 millionths inch, and "uncomfortable" sounds to 1000 $\mu\mu$ =1 μ =40 millionths inch.

It must in fairness be conceded that even when the telephone receiver diaphragm is an uncomfortably aggressive neighbor, it does not exact much elbow room. But for the benefit of those who have advocated molar versus molecular motion of the diaphragm, one may say with Galileo, as of old, *"E pur si muove,"* although Galileo contemplated a movement of the earth on a larger scale than that here considered; to wit, a round million and a half of miles daily. As a matter of principle, we know that a telephone is an alternating-current motor, to which a small part of the power of a speaker's laryngeal muscles is transmitted electrically from a great distance; but it is a motor that only "motes" through a space of a few millionths of an inch, and the power of the motor expressed in kilowatts would have a very modest look.

ARMATURE REACTION OF ALTERNATORS.

A remarkably easy way to picture the effects of armature currents of a polyphase alternator on the magnetic circuits of the machine is obtained by considering the rotating field set up by the polyphase armature currents. If the load is balanced between the phases in all respects, this rotating field is of constant strength; and, since the rotation with respect to the armature is in perfect synchronism with the armatures rotation with respect to the field magnets of the machine and in the opposite direction, this rotating field has no motion with respect to the field structure but is simply a cross magnetizing or demagnetizing component of the field magnetization according to conditions. For instance, in a revolving-armature machine, the revolving field set up by the armature currents is stationary in space, while in a revolving-field machine it rotates in synchronism with the field magnets, although not in phase with them, if we may be permitted to use the term, "in phase with," somewhat out of the ordinary.

This method of looking at the armature reaction leads at once to several conclusions. In the first place, if the armature currents are in phase with the induced e. m. fs., the armature reaction will be purely a cross magnetizing or field distorting tendency, not tending to strengthen or weaken the main field except in so far as the distortion crowds the lines of force and thereby increases the reluctance of the circuit. This is due to the fact that the armature coils are midway between the poles when they are the seat of the highest e. m. fs., and are immediately under the poles surrounding the total flux when the seat of no e. m. fs. The currents being assumed in phase with the induced e. m. fs., the coils under the poles and embracing the flux will have no current and consequently no magnetic effects, while those midway between the poles, their sides cutting the flux, will have maximum currents and maximum magnetic reaction, which, from its position, must be distorting or cross magnetizing. The reaction is closely analogous with that of direct-current machines with brushes so set as to give commutation midway between the poles.

It is noticeable, however, that in practice the currents are rarely in phase with the induced e. m. fs. Even in the case of a purely non-inductive load, the currents lag behind the induced e. m. fs. due to internal reactance, although they do not lag behind the impressed e. m. fs. given to the terminals. This lagging causes the direction of the armature reaction to swing around until it has a component directly opposing the field magnetization as well as a distorting component. Thus the armature reaction resembles somewhat that of direct-current machines with brushes set at a lead to obtain improved commutation. With most alternators there are in addition to the internal reactance, those of lines and transformers, still further increasing the lag and in consequence the magnitude of the demagnetizing component. It is noticeable that in alternators the direction of the armature reaction shifts ahead as the field is distorted in that direction, the armature reaction adjusting its angle to the magnetic rather than to the structural embodiment of the field. This action is entirely different from that of direct-current machinery where the reaction has a fixed direction regardless of the amount of the field distortion. It is also noticeable that the demagnetizing component of the armature reaction increases more rapidly than the load increases, due to the fact that with diminished external resistance, the internal reactance becomes relatively larger, causing a greater lag of the currents. For these reasons among others, the matter of armature reaction in alternators is a serious problem, although there is no commutation with which it can interfere.

In the case of large alternators it becomes an unusually difficult problem to solve, especially if the machines have a high peripheral speed or a low frequency, either of which gives a large number of armature turns per pole, calling for a correspondingly large number of field turns to prevent the armature from becoming too powerful relatively with the field. This large number of field ampere-turns, with a field of ample cross section and an air gap of moderate width, gives too high a density, causing abnormal iron losses in the armature laminal and particularly in the teeth. To avoid this either the air gap can be increased or the cross section of iron in the field structure can be reduced. The two methods give different results in that one carries the density further around the saturation bend of the machine than does the other.

Opinion seems to be divided as to their relative merits. In a comparison drawn recently in these columns between two machines differing in this respect, it was stated that on account of the higher density of one, there is required a smaller percentage increase of excitation to maintain the voltage as the load comes on. This was slightly erroneous, the regulation being improved somewhat with the higher density only in the sense of a smaller rise of armature voltage on throwing off the load. The same article stated that the Niagara machines required 50 per cent. increase of the no-load exciting current to maintain normal voltage with full load. We are informed that this figure is in error, the actual figure being 20 to 22 per cent. This increase exists in spite of an air gap of ¾ of an inch, and is directly due to the high speed of rotation and consequent easily attainable high peripheral speed as compared with most engine-driven units. This high speed with the low frequency of 25 cycles requires poles spaced a wide distance apart, giving a great many armature turns per pole and consequently a high armature reaction. The same comparative high-pole speed gives the machines many and great advantages that much more than compensate for this slight disadvantage, which indeed is of academic rather than practical importance.

Large Water Power Development in Maryland.

A Baltimore despatch says that surveys have been completed for the large water-power electric plant on the Susquehanna River, near Conowingo, Md. It is stated that the first station to be erected will have a capacity of 50,000 electrical horse-power ,and that power will be transmitted to Baltimore and Philadelphia. A bill recently passed by the Maryland Legislature authorizes Baltimore city to issue $1,350,000 bonds for a municipal lighting plant and to make a deal with the Susquehanna power company for current. It is expected that the new plant will be in operation in 15 months. It is asserted that the electrical power can be transmitted to Baltimore, Wilmington and Philadelphia at one-half the present cost of steam power in those cities.

A Pittsburg despatch states that the electrical contractors of the United States will hold a convention in New York City about Sept. 1 next. The despatch adds that the organization has adjusted with the supply houses all differences relative to prices

A Century of Copper.

The remarkably rapid expansion of the copper industry in the United States and the large proportion which this country supplies of the world's copper consumption is illustrated by some figures presented by a German publication entitled "A Century of Copper," a translation from which has just reached the Treasury Bureau of Statistics. It shows that the United States has during the decade 1891-1900 produced more than half the copper of the world, while in the preceding decade, it supplied about one-third of the world's production and in the decade 1871-'80, the proportion supplied by the United States was only about one-sixth of the total. The growth of copper production in the century has, according to this statement, been very rapid, being in the first decade 91,000 tons, in the fifth decade 291,000 tons, and in the tenth decade, which ends with 1900, 3,643,000 tons, of which 1,963,000 tons are supplied by North America, the large proportion of this being from the United States. The greatly increased demand for this material is further illustrated by the fact that although the production has increased from 505,909 tons in the decade 1851-60 to 3,643,000 in the decade 1891-1900, the average price, according to the publication in question, has only fallen from £111 per ton to £52 per ton, production having during that time increased more than six-fold, while the price fell but about one-half. In the matter of consumption the figures are equally interesting. A table showing the consumption of England, France, Germany and North America, gives the total consumption in those four countries at 409,583 tons in 1899, against 268,447 tons in 1893, being an increase of about 50 per cent. during the period under consideration; while in North America alone, the production is given at 77,433 tons in 1893 and 162,000 tons in 1899, the growth being over 100 per cent. during the period.

Third Avenue Leased to the Metropolitan Street Railway Company.

At a recent meeting of the directors of the Third Avenue Railroad Company and the Metropolitan Street Railway Company, the former road was leased to the Metropolitan for a term of 999 years, the lease being subject to the approval of the stockholders of both companies, who will meet in the early part of May. At the close of the meeting, which was held in the office of President Vreeland, of the Metropolitan Street Railway Company, that official said that because of the uncompleted condition of the Third Avenue and subsidiary lines, the Metropolitan directors considered it would take three or four years to put the property in shape, so, with that fact in mind, the following terms were agreed upon:

The Metropolitan agrees, first, to guarantee the principal and interest of the Third Avenue bonds; second, to pay to the Third Avenue Company for the first four years of the lease the net earnings of the system above fixed charges and operating expenses; third, to pay for the next two years 5 per cent. on the Third Avenue's capital stock of $16,000,000; fourth, to pay for the next four years 6 per cent. on the capital stock, and, fifth, for the balance of the term of the least to pay 7 per cent. This proposition, which was signed by Walter S. Johnston, chairman of the Board of Directors of the Third Avenue Company, was accepted and ratified by the Metropolitan directors, subject to the approval of the stockholders of both companies.

Subsequently the official announcement was made that Messrs Kuhn, Loeb & Co., were to take $35,000,000 bonds of an issue of $50,000,000 on Third Avenue property, $15,000,000 being reserved to take up the underlying securities as they matured, and that the Metropolitan Street Railway Company would guarantee the principal and interest of the bonds. The proposition of Messrs. Kuhn, Loeb & Co. was accepted by the Third Avenue Company, and the Metropolitan Street Railway Company guarantees the bonds as above indicated. The arrangement for a public offering of the $35,000,000 of the Third Avenue 4 per cent. bonds will, it is reported, not be completed for several weeks, until after the issue is first approved by the stockholders of the company.

Judge Lacombe has signed an order authorizing Receiver Grant, of the Third Avenue Company to borrow the amount necessary complete the construction work in Amsterdam Avenue and issue his notes or other obligations therefor. The order directs Receiver Grant, among other things, to change over the present system from 187th Street to 194th Street, and to lay the double crossover at 194th Street, all at a cost not to exceed $79,684.00. A second order directs the receiver to purchase and draw into the ducts from 161st Street to 195th Street 68,620 feet of insulated wire at a cost not to exceed 93 cents a foot.

Power Works Destroyed by Flood.

The canal and power house of the Hannawa Falls Water Power Company, at Hannawa Falls, on the Raquette River, four miles from Potsdam, N. Y., was almost completely destroyed on April 18 by high water, causing a damage variously estimated at from $25,000 to $75,000, and probably delaying the completion of the water power plant one year. The Hannawa Falls Water Power Company is developing at Hannawa Falls a water power plant of 12,000 horse power, and, it is said, is contemplating developing all the important powers above that place on the Raquette River, amounting probably to upward of 100,000 horse power. It is reported that the new 2,500-horse-power dynamos which were sanding on the river bank have been carried away by the flood. Sections of the steel penstocks, 10 feet in diameter, were carried away and the canal banks are said to be giving way in many places, flooding all the surrounding country.

Electric Wiring in New York City.

In a report to Fire Commissioner Scannell, of New York City, regarding fire losses last year, Fire Marshal Seery refers to the electric hazard. On this subject he says he is convinced, after a number of rigid examinations that not a few of the fires are the result either of defective insulators or imperfect wiring. The openings left in walls and partitions for burglar alarms, electric bells and electric light wires, he says, should be made fire-proof as each opening may be considered a flue, allowing flames to spread throughout the building For the public safety, and to provide against this danger, he recommends the licensing of all persons handling electric light appliances, and to make all openings for wires fireproof. He also recommends that regulations be established providing for cut-out boxes in the inside of buildings near the main entrance, so that currents may be readily turned on or off as occasion requires. He further suggests the appointment of an electrical expert to be attached to the Bureau.

American Society of Mechanical Engineers.

The forty-first meeting of the American Society of Mechanical Engineers, will be held at the Grand Hotel, Cincinnati, O., May 15 to 18, 1900. The programme includes twelve papers and a topical discussion on "What Does It Cost to Run Trains at High Speed." Among the papers are the following: Geo. I. Rockwood, "On the Value of a Horse-power." H. T. Yarvan, "Hot Water Heating from a Central Station." W. S. Aldrich, "Systems of Efficiency of Electric Transmission in Factories and Mills." Arthur Herschmann, "The Automobile Wagon for Heavy Duty." B. C. Ball, "Cylinder Proportions for Compound and Triple Expansion Engines." A number of excursions will be made to points of interest in Cincinnati or vicinity, and a visit to the National Cash Register Plant at Dayton, O. The social features will consist of a reception and conversazione at the Hotel Alms, and several entertainments by the ladies' committee to the visiting ladies.

The Polyphase Distributing System of the Metropolitan Street Railway Company of New York City—V.

By J. E. Woodbridge.

THE SWITCHBOARD OF THE GENERATING STATION.

IN this plant the term switchboard becomes a misnomer, as the "switch gear," to use an English term, has not been concentrated upon a single board, but—in order to prevent burn-outs from spreading—has been scattered over a considerable area with ample air-space between the parts. The number of switches used in this plant, spread out in this way, occupy four galleries, one above another, running the whole length of the west end of the operating room, the available space in each gallery being about 80 feet long by 20 feet wide. This scattering necessitates some sort of a local connection between the various devices used and a central keyboard from which they can all be manipulated. The lowest of the four galleries contains the instrument boards, the operating boards and the field rheostats. The second gallery contains the bus bars and 22 oil circuit breakers—two for each generator. The third gallery provides space for the 20 group circuit breakers and the fourth is occupied by the 80 feeder breakers and the static dischargers for 80 feeders. A section through these four galleries, indicating the arrangement of these devices, is shown in Fig. 19.

Below the lowermost of these four galleries are the exciters, consisting of three Ideal tandem-compound horizontal engines direct coupled to 125-volt generators, one of them having a capacity of 600 amperes and the other two 1280 amperes each. The smaller set is capable of supplying sufficient exciting current for two of the large alternators, while each of the other two exciters can supply current for four of the main alternators. The floor occupied by the exciters is on a level with the floor of the main operating room, and immediately below it on the ground level is one of the rotary-converter sub-stations, below which again is the basement occupied by sub-station wires and oil circuit breakers, forced-draft air ducts for the sub-station transformers, etc.

In addition to the three engine-driven exciters there will be three exciters, each of 150-kw capacity, driven by induction motors. These three induction motors will be supplied with current by two 350-kw transformers, exactly similar in size and winding to those used throughout the sub-stations, the two transformers being V-connected, that is, in an open delta, the third side of the delta being unfilled owing to the ability of two transformers of this size to carry the load. These transformers are made of uniform size and winding with the sub-station transformers, so as to secure interchangeability.

The short-circuit-proof construction of the bus bars mentioned above is indicated in the sectional elevation through the galleries (Fig. 19), and is shown in greater detail in Fig. 20. Running the whole length of the gallery *D* is what might be termed a "bus-bar chamber" which is enclosed by a brick wall at the back and a soapstone cover overhead. This chamber, 80 ft. long by 5 ft. wide and 8 ft. high, is divided by soapstone floors into three levels, one above another, each level carrying the bus-bar of one leg of the system. As the illustration shows, the bus-bars are supported on corrugated porcelain insulators bolted down to the floors and below the bolt heads are other 2½-in. soapstone slabs with cement dowels in their joints, forming continuous barriers, isolating each bar in its own compartment, so that no arc can find its way from one bar to the next. Fig. 20 shows the construction at the Ninety-sixth Street end of the bars, which is the right-hand end in the general diagram, Fig. 17, published in the last issue of the Electrical World and Engineer. The arrangement of the bars will be rendered clearer by comparing Fig. 20 with the general diagram previously published, the same connections being similarly named and numbered on both.

It will be noted that the multi-blade bolted knife switches which divide the bus-bars into sections, pull open in a horizontal plane toward the front of the compartments. In front of each one is a catch against which the switch strikes when pulled slightly out of contact. This is to prevent anyone from pulling this switch wide open when current is flowing over it. When pulled out to the catch it will draw a short arc if current is flowing and can be pushed back again. The source of current can then be hunted for and cut off by means of generator and feeder oil circuit breakers. If no arc forms on pulling the knife switch out to the catch the latter can be pushed down, when the switch can be opened wide. This arrangement is to prevent any possibility of pulling an arc sufficiently long to jump around a barrier to another bus. It will be noted that similar parts of the

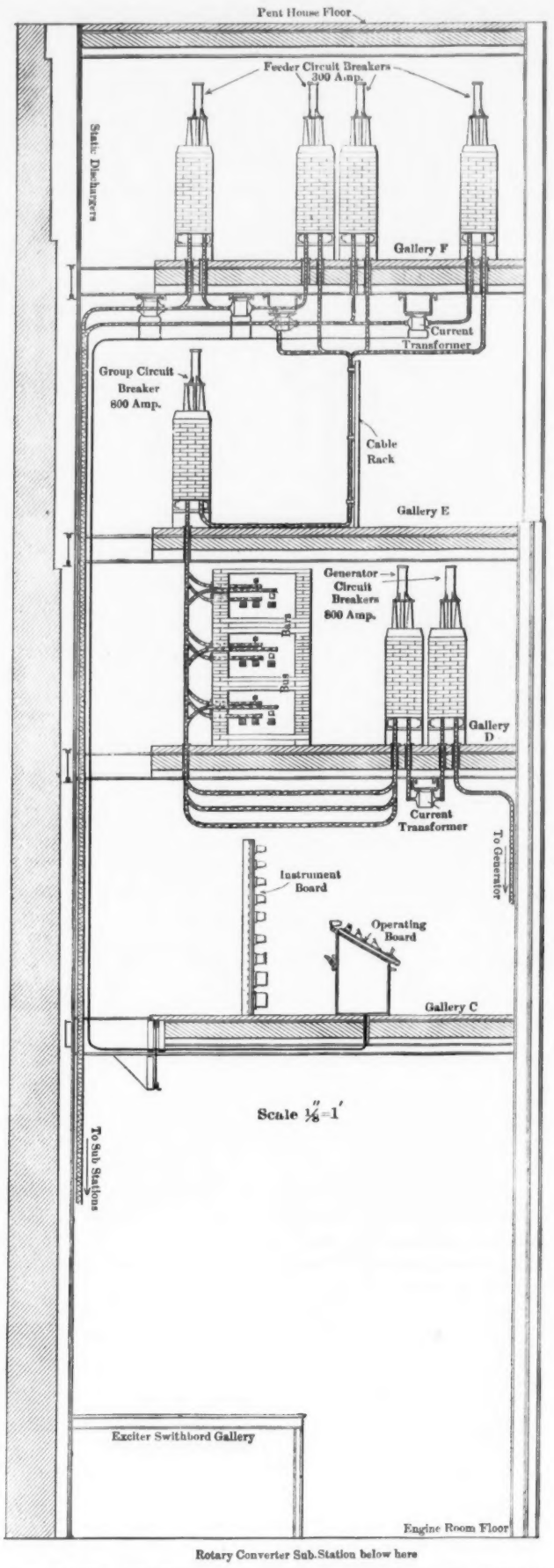

FIG. 19.—SECTION THROUGH SWITCHBOARD GALLERIES OF GENERATING STATION.

three bus bars are slightly displaced from positions directly over each other in order to separate the cables running down to the generator circuit breakers and up to the group circuit breakers.

The arrangement of the instruments is indicated in Fig. 21, which shows a front elevation of the generator instrument board. This

instrument board will be made up of 13 blue Vermont marble panels, the three panels at each end being swung around at an angle of about 50° with the centre of the board so that all instruments will be clearly in view from the operator's position in front of the handling apparatus which is grouped on the inclined surface of an operating board located centrally in front of the instrument board, tors, an arrangement necessitated by the impossibility of getting the 11 heavy rheostats for these large generators within mechanical reach of the operating board. The operating switches of the rheostat motors have four running positions, giving two speeds in each direction. On each generator panel of the instrument board is a lamp connected to contacts on the motor-driven field rheostat in such a

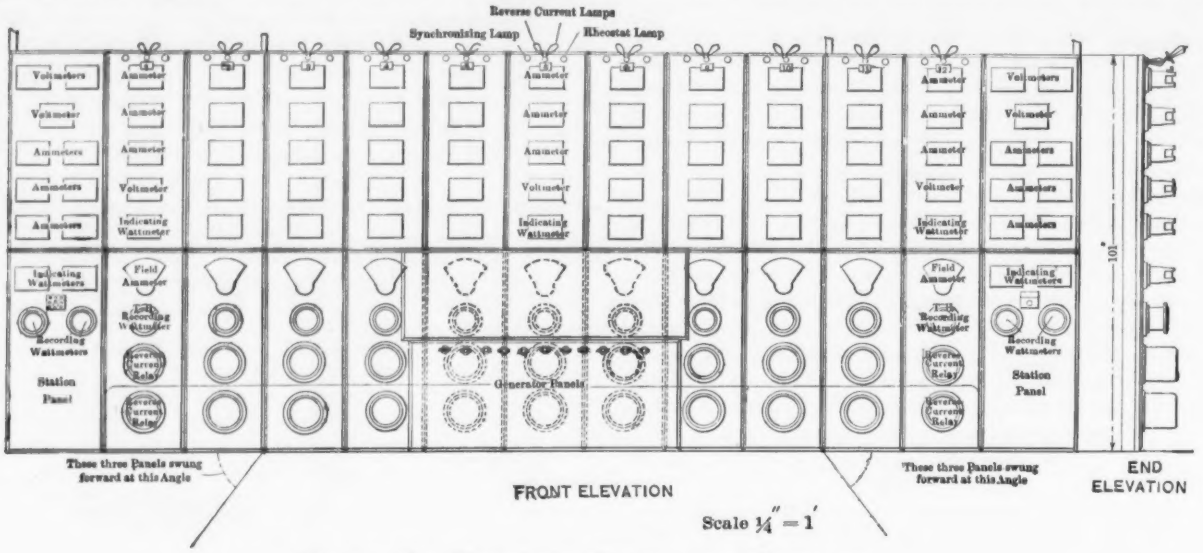

FIG. 21.—THE INSTRUMENT BOARD OF THE GENERATORS.

as indicated in Fig. 19. There will be two of these sets of instrument and operating boards on gallery *C*, one for the generators and one for the feeders. The operating boards are of the bench-board type with surfaces inclined 30° from the horizontal. The arrangement of apparatus on flat for the generators is shown in Fig. 22. The 11 field switches of the generators (with the usual discharge clips) are mounted in a row along the back of the generator bench way that it is illuminated every time the moving contact of the rheostat rests centrally on any segment. Below the rheostat controller on the bench board are the two controlling switches for the two electropneumatic oil circuits breakers. Below these is the controller of an engine speed regulator, consisting of a motor which varies the restoring weight of the engine governor. This regulator is for use in synchronizing (making it possible to synchronize on the

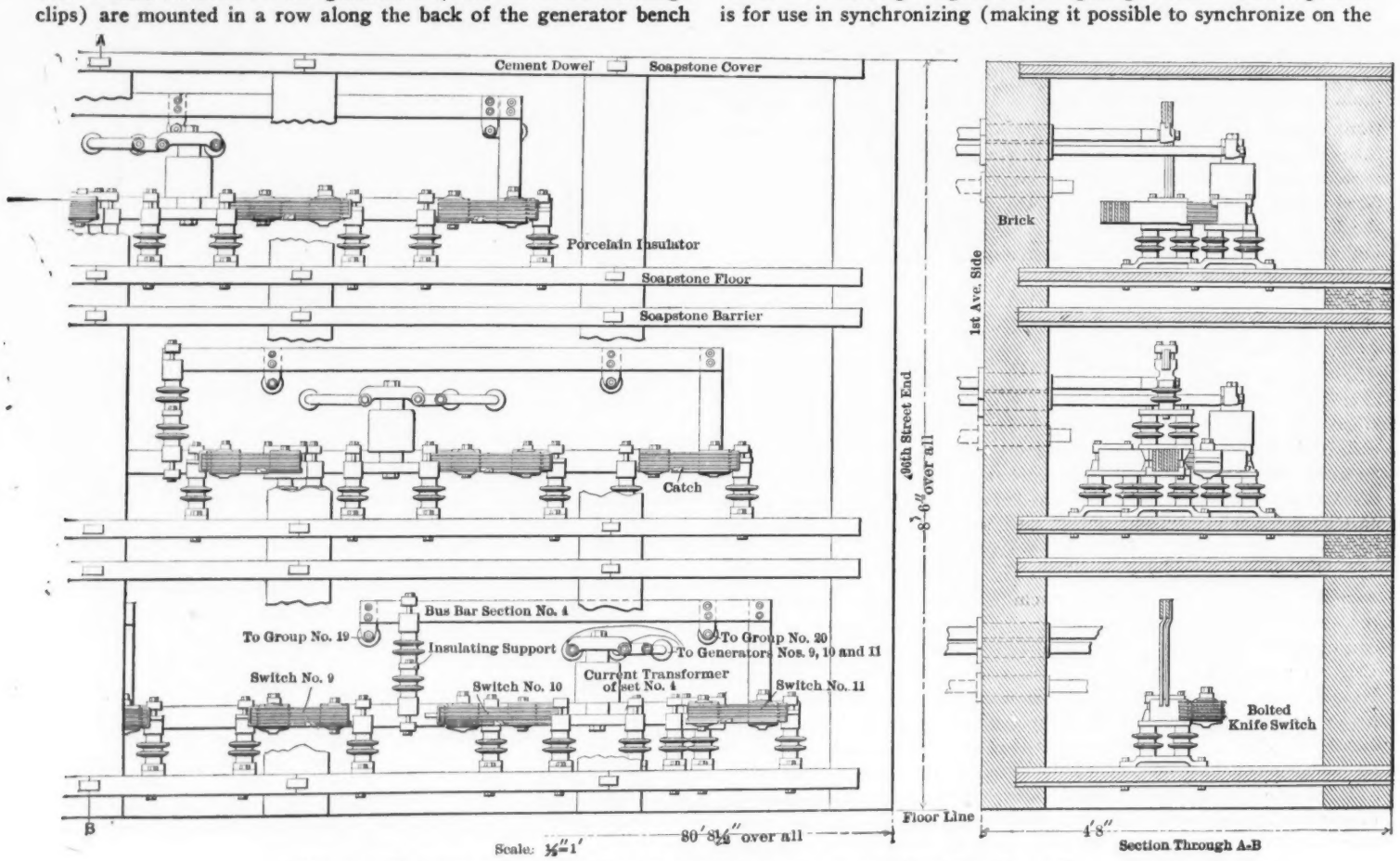

FIG. 20.—ELEVATION OF AND SECTION THROUGH ONE END OF THE BUS-BAR CHAMBER.

board with handles coming through to the front. The top of the board contains 11 rows of switches, plugs, etc., one row for each generator, each row being made up of the following devices: At the back or top is a synchronizing plug; below and in front of it is the controlling handle of the field rheostat. These field rheostats are unique in that they are operated by electric mo- governor) and for controlling the division of the load, thus giving a visual signal when the rheostat arm rests squarely and centrally on a contact. Bracketed to the upper rear edge of the operating board is one synchronizing voltmeter. On the front of the board are emergency controlling switches by which the oil circuit breakers of all of the generators of one set can be thrown out simultaneously.

Eleven of the 13 panels of the instrument board are for the 11 machines and carry the instruments indicated in the drawing. The other two panels, one at each end, are station panels, each one containing the two vertical rows of instruments shown in the elevation of the board, these four rows indicating the electrical quantities of the four sets of machines into which the eleven machines are divided. There is no main panel indicating the output of the whole station.

The exact arrangement of the circuits is indicated in much greater detail in Fig. 23. It will be noted that between each of the machines and the main bus-bars there are two oil circuit breakers in series with each other. These are provided so that if one fails to open the other will be available, and also to allow the switchboard operator to try them one at a time (while the other is open) and make sure that both will operate promptly before throwing in a generator. This is to provide against the chance of a circuit breaker sticking or failing to act promptly, which would naturally give considerable uncertainty in the operation of synchronizing.

Among the other features of these circuits which may be noted is the use of a different synchronizing plug for the machine that is running from that used with the machine that is to be synchronized. The circuits of the receptacles and plugs are such that a light on the panel of the machine to be synchronized as well as one on the start-

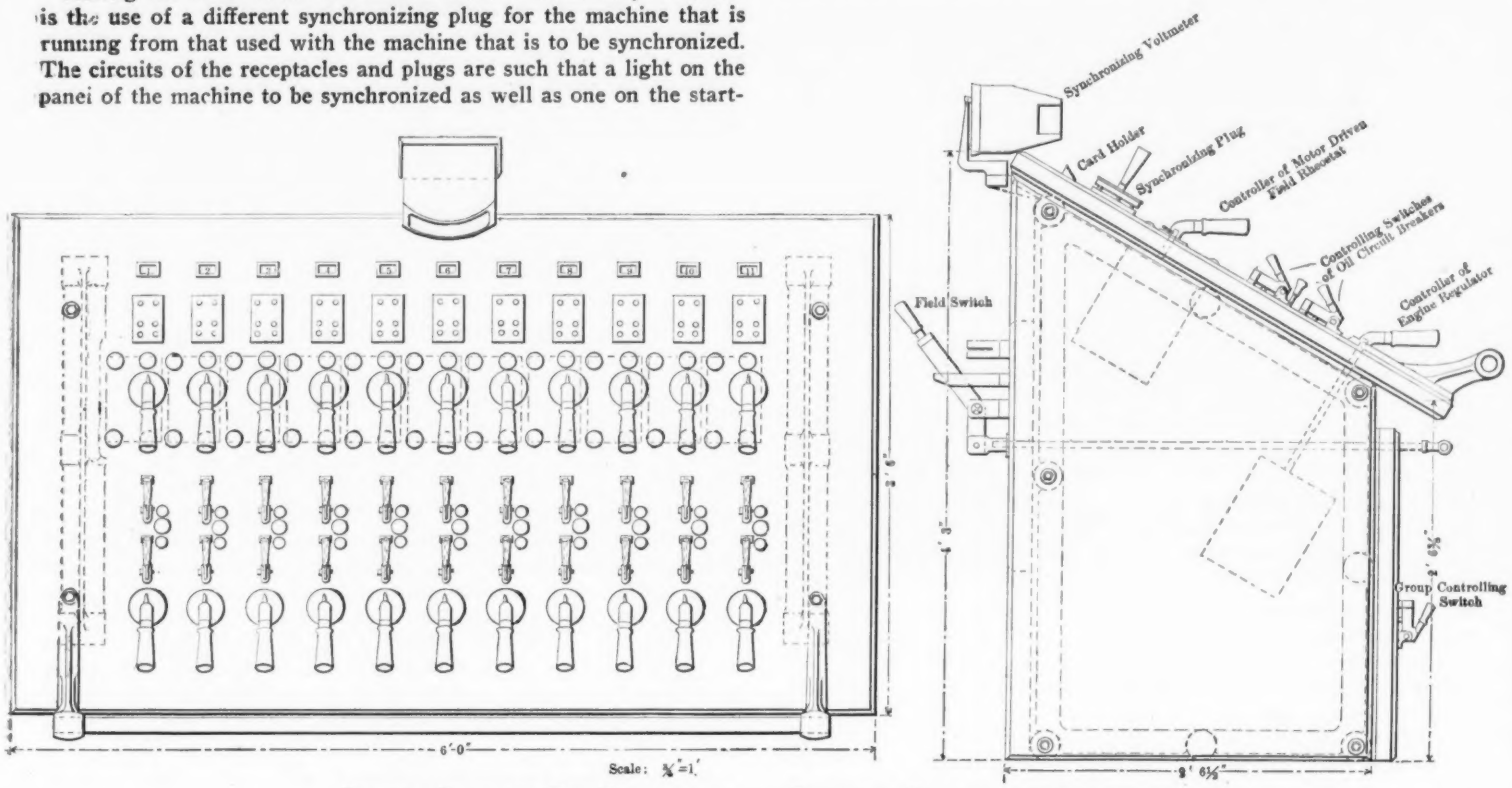

Fig. 22.—Plan and End Elevation of the Operating Board of the Generators.

ing platform of the corresponding engine are connected to the synchronizing transformers, giving an indication to the engine attendant of whether the engine is or is not running at the proper speed.

No automatic circuit breaking devices of any kind whatever will be connected between the machines and the bus-bars, as the generators are amply able to carry for a short time any load within the ability of the engines, and will readily carry a dead short-circuit current for brief intervals without overheating. It will be noted, however, from the elevations of the instrument board that there are two reverse-current relays on each machine panel. These reverse-current relays are designed to light a pair of red lamps on the corresponding panel in case power tends to flow from the bus-bars into the machine instead of from the machine into the bus-bars, as for instance would occur if the steam were entirely shut off from a unit when running in parallel with others, compelling the generator to act as a synchronous motor. The lighting of these lamps on any one of the 11 panels causes a bell to ring. The purpose of the reverse-current relays, lamps and bell is to indicate any fault in the machine winding, as for instance a partial short circuit in one phase, leaving the disconnection of the offending machine to the discretion of the switchboard attendant.

The two relays per machine are connected in two separate legs so that a reversal of the current in any one of the three Y-connected machine windings would be indicated on one or the other, or both of them. The reverse-current relays are of the same type as those described above in connection with the oil circuit breakers.

The Opening Week of the Paris Exposition.

AT this moment, 18 hours before the opening of the great Universal Exposition of Paris, in the year of our Lord 1900, and on that Friday which of all others is usually devoted to seclusion, contemplation and the quiet exercise of religious duties, all is a-quiver with noise and confusion inside the precincts of the show. Nor is the excitement less outside. All Paris is trying to penetrate into the grounds or is speculating as to what is going on there. For to-morrow, Holy Saturday, chosen for some reason more or less inexplicable as the date of the official opening, the most elaborate preparations are being made. Why Easter Monday would not have been the best of days for a "send off" no foreigner can say, as it would have hit better the pious feelings of a large proportion of the people of France, and would have gained three days for preparation, now so sorely needed. Still, the French are themselves in control of this matter, and all there is left is to record the facts.

In themselves, the facts are sufficiently serious, as to the incompleteness of everything, so that May 14 would have answered much better for the official opening exercises. The more irreverent Parisian journals insist that only the facades along which President Loubet will pass to-morrow are putting on a fictitious air of readiness and gaiety, and that all the rest is wild chaos. There is more or less of truth in this, as there is in the frankness of all bosom friends who have truths to tell, but it would not be fair to underrate the work that the authorities are doing. Everything has been planned in advance with great care and ingenuity, and while the plan may break down here and there by its own complexity, it is very useful where it is carried out in practice. The roughest chalk mark is serviceable for purposes of alignment, and in France the chalk mark has usually been laid down with all the solemn dignity of a stone foundation. The Gallic race carves heads on cheiry shells with as much earnestness as on immortal buildings.

The congestion is worse congested at the instant by the sudden orders of the blockade issued. A few days ago the command went forth that from April 11 to 18 no more railroad cars were to be allowed in the grounds. This was intended to give some five or six hundred already on the tracks inside a chance to unload and get out; but it leaves on the sidings of the five railroads centering in Paris not less than 1100 loaded cars at the moment the order went forth. By this time there are probably 1500, as reports come from Havre and other frontier points that more material is pouring in. Whole exhibits of importance are known to be at Havre, for the electrical and mechanical or transportation sections, but there they

will stay temporarily. There are some short circuits you cannot burn out. In addition to this embargo, an order was also issued a day or two ago that after Wednesday, April 11, no wagons or carts were to come in until next week, so that all the approaching streets and avenues have been blocked by such vehicles, from which furniture, material, machinery, etc., has been taken by hand and transported through long aisles by human labor, across mounds of dirt, open electric trenches, and worse barriers than the Boers have opposed to the English in the Transvaal. To the 100,000 laborers have been added thus swarms of porters, and these again have been supplemented by brigades of French soldiers armed not with musket, but with broom and spade, making straight the way for the President.

It has been announced that after the opening exercises in the Salle des Fêtes—now an echoing void of future splendors—the President to-morrow will pass along the front of the American Court of Honor, where the sacred relics of so many inventions associated with the development of machinery and electricity are housed as souvenirs of the century's advance. This is a marked courtesy, and there has been acorresponding effort to acknowledge it by getting all in readiness. Mr. J. S. Anthony, the assistant director of machinery and electricity, has succumbed to the strain, after working night and day; and Director Drake, with the aid of Messrs. Malcolmson, Geisenheimer, Gurd, Weinsheimer and others has pushed the court through until it is marvelously complete, although a short two weeks ago the floor had but just been laid, without a leakproof ceiling above it.

The actual condition of affairs within a few hours of the opening ceremonies was far from being complete. The steam plant is far from ready, and none of the engines or pumps depending on it have been able to turn over, although as a matter of fact some of the direct-connected units are in perfect working order. So that although flags are flying everywhere and illuminations are the order of the night, it will be some time before the fitting electrical displays can be seen. The national holiday of July 14 (Bastille Day) will be for many the first opportunity to see the Exposition in full nocturnal regalia. Those exhibitors whose previousness has enabled them to be ready for Saturday have carefully muffled up their machines and cases and gone off where the dust is not so thick and where exhibits are less technical but perchance more amusing. Besides, one can get too much fresh air, and there is not at this instant a single door fitted to any part of the ground floor of Electricity Building. April is not the balmiest month in Paris.

Out at Vincennes, a good deal of progress has been made, and Director Drake was able to report to-day with justifiable pride that steam was actually up in the American Mechanical Building. The difficulties in the completion of work out there, over six miles from the main exposition, must have been encountered to be realized, and it must be borne in mind that a large part of the power plant went down in the "Pauillac." Moreover, the railroad to the grounds was not ready, so that the Morrin boilers and the Ball engine had to be hauled in trucks over inferior dirt road. The electric crane was not available, from the same causes, although the frames helped to some extent. Current might have been obtained from an electric railway power-house about a mile away, but could not be secured, for some esoteric reason not comprehensible by the average mind. The Ingersoll-Sergeant Rock Drill Company have their exhibit in splendid shape, thanks to the energy of Mr. J. J. Swann, and their plant is running, able to supply 1000 cubic feet of pure air per minute, representing about 350 horse-power, to turn over engines, operate tools, signals, etc. The exhibits of Brown & Sharpe, Pratt & Whitney, Norton Emery Wheel Company, Q. & C. Company, Fay & Egan are well forward, and the same is equally true of the exhibits of the Baldwin Locomotive Works, Westinghouse Machine Company, Smith & Wesson fine arms and target exhibit, etc. The Transportation Building is very much behind and the Automobile Building is also incomplete. The McCormick Harvester Works are putting up a separate building. In a great many of these instances the use of electric motors is an important feature.

Returning to Electricity Building on the Champ de Mars, it may perhaps be of interest to note that the exhibit of the McGraw Publishing Company, inclusive of the ELECTRICAL WORLD AND ENGINEER, the *Street Railway Journal* and the *American Electrician,* is the first to be occupied for work and the first to be enclosed, probably for the reason that the exhibit consists of publications rather than heavy machinery. Files of the respective publications are already to be found there, as well as the forty or fifty technical books issued by the concern, and bound volumes of each paper. Complete handsome sets of all the present journals and their component predecessors had been secured and bound at great expense, but were lost on the "Pauillac." These have been replaced, for reference and the use of visitors. All electrical engineers visiting the Exposition are requested to call and register, as the exhibit has already become headquarters for information and a register and card catalogue are maintained of all American engineering names, etc., likely to be of use in Paris. There are writing accommodations for such visitors and for ladies with them, and the space is most central, being immediately in the rear of the Chateau d'Eau, which constitutes the great feature of attraction on the Champ de Mars, and which stands right in front of Electricity Building. Telephone service is also available for all parts of the American section, for Vincennes and for the world at large outside the show. Mr. W. H. Donner has been placed in permanent charge of the exhibit, with a staff of assistants, and the three journals will be editorially represented throughout the continuance of the Exposition.

Mr. Maurice Coster, of the French Westinghouse Company, has had current ready this week for the third rail exposition road and the moving sidewalk, and has carried out some most satisfactory tests, with the current fed into the transformer house from the power plant out at Billancourt. The trains and the sidewalk run admirably and promise to be a great boon to everybody. As a matter of fact, while the sidewalk is a great novelty here, the third rail system is hardly less so.

Large Water Power Development in Canada.

One of the most important of the many power developments now being carried forward in Canada is that on the Saguenay River, near Chicoutimi, Que., for the production of calcium carbide. On Feb. 5 last Mr. T. L. Wilson, of St. Catharines, Ont., bought from the Quebec government the Saguenay power at tide water, which is capable of development of 69 feet head and will give over 200,000 horse power. At this point the Ship-Shaw River falls into the Saguenay, and has quite a flow of water, giving at its minimum about 15,000 horse power under a development of 138 feet over the water wheels the total fall being over 150 feet. Here Mr. Wilson proposes first, to develop 10,000 electrical horse power on the Ship-Shaw, and a second development of 100,000 horse power on the Saguenay, leaving a further possible power development on the Saguenay of another 100,000 horse power. The development of 10,000 horse power on the Ship-Shaw River is now proceeding. There will therefore be an immense quantity of electrical power available for renting to other industries, and being on tide water the location would afford a most advantageous situation for manufacturing industries, particularly that of wood pulp and paper mills, it being the centre of the finest pulp wood district in the world.

The Canadian Electrical Association.

It is expected that the citizens of Ottawa will display their characteristic spirit of cordiality to the visiting delegates on the occasion of the convention of the Canadian Electrical Association which will take place at the capital of the Dominion on June 27, 28 and 29. Arrangements are already well advanced for the convention. About six papers are to be read. Among them will be one by Prof. R. B. Owens, of McGill University, Montreal, on "Utilizing the Available Central Station Capacity," and another by Mr. F. H. Leonard, of Montreal, on "The Effect of Power Factor on the Operation and Investment, with Special Reference to Induction Motors and Enclosed Arc Lamps." Mr. A. A. Dion, of Ottawa, is chairman of the local reception committee.

Electric Railway in Nottingham, England.

The tramway system of Nottingham, England, which is owned by the municipality, will soon be transformed into an electric system. An indication of the backward state of the electric railway industry in Great Britain is given by the announcement that "Contracts for experimental motors have been placed in Sheffield, and if not satisfactory upon trial, other offers will be considered."

Commercial Electrical Measurements and Prices—1.

By William D. Marks.

The word "commercial" indefinitely enlarges the field of electrical measurement by the introduction of the factor of the cost of production and of the price of the electrical current delivered through an electrical meter for the production of light and power at the point of purchase. No mere theory as to the cost of the plant and of its operation is of any value. The actual figures, deduced from the cash costs of an operative plant of sufficient size to produce light and power in quantity required for a city's use, must be obtained. No rational and correct basis of costs can be deduced from the capitalization of companies for which franchises, really though not openly exclusive, have been obtained through "political pull."

Too often it is the fact that parties obtaining these municipal privileges capitalize the company for only a small fraction of the sum really invested. The securities offered to the public are usually divided into bonds, preferred stock, and common stock. It is usual to make the bonded indebtedness about equal to the cash investment and to sell the preferred stock with a bonus of common stock for "improvements."

The station is built and the company, with its curiously blended load of legitimate business speculation and watered stock, is floated through the agency of political jobbery and stock washing. Of course, there is but one way to make its expanded securities valuable, and that is to take advantage of a monopoly—to charge more than a fair profit on the light and power produced. The views of the industrious and able financiers promoting these companies as to how much "water" investors will take or how much overcharging consumers will stand vary so greatly as to render it impossible for the constructing engineer to make a regular allowance for it in his estimates of prices. In what follows the writer will confine himself to actual cash costs. At present prices for light and power it may be assumed with average correctness that each $20,000 of gross annual income requires about $100,000 cash investment in most of the presently existing electric light and power stations throughout the United States. The writer will take the carefully kept figures of a large incandescent light station for the basis of his work:

Cash cost of station distributing system and offices		$2,000,000.00
Ultimate capacity of station in 16-cp, 110-V. lamps		120,000.00
Number of 16-cp, 110-V. lamps actually attached		89,359.00
Gross annual income		$411,315.30
Gross annual fixed expenses	$132,677.99	
Gross annual variable expenses	88,132.78	
		$210,810.77
Gross annual profit		$200,504.53
Gross annual income per lamp attached		$4.60
Gross annual fixed expenses per lamp att	$1.46	
Gross annual variable expenses per lamp att	.98 6-10	
		$2.446
Gross annual profit per lamp attachment		$2.154
Gross annual sales of 16-cp lamp-hours (447-1000 amp.)		62,702,714
Income per lamp-hour sold		0.656 cent
Fixed expenses per lamp-hour sold	0.210	
Variable expenses per lamp-hour sold,	0.140	
		0.350 cent
Profit		0.306 cent

There are certain practical and approximate relations existing between the various figures given which are of service in all stations. By fixed charges are meant those charges which would go on if the fully equipped and manned station was stopped and not delivering any current for a short period. You will note that these are about 6 6-10 per cent. of the cost of the station. By variable charges are meant coal, labor, firing and handling, oil, waste, lamp renewals, etc., all of which are consumed in proportion to the output of the station. It will be noted that these are about 21.4 per cent. of the gross annual income, and that the cost of the plant per lamp capacity is $16.67 per 16-cp incandescent lamp.

These figures will serve for rough estimates and comparisons of others with the existing Edison Electric Light Station of Philadelphia, which was designed, built and operated by the writer during the years of 1887 to 1896, and from which he has mostly drawn his figures, knowing them to be accurate, as the writer personally organized the business and methods of bookkeeping. This station, after paying 53 per cent. in dividends in four years, was finally sold for $1,000,000 cash more than it cost, and therefore can be regarded as a practical success.

From the preceding data we find that the average number of hours each of 89,359 attached lamps burned was 701.7 hours in a year of 365 days. It should also be stated that at the heaviest load output only a little over one-half the lamps attached were burning. Fifteen per cent. annual profit on the cash investment in a 120,000-light plant costing $2,000,000 should be a liberal allowance to a monopoly as covering a fair dividend and allowing for deterioration.

The great reduction of cost due to long hours of burning is due to the fact that the variable charges only are increased. The fixed charges remain constant per year per lamp. We have practically observed that not more than one-half the lamps or power are going at once. If all attached should go on at once, a doubling of the power of the generating machinery would be required, and for this reason in the appended computations of prices it is not advisable to carry the computations further than eight hours' use of current.

Fifteen is a fair percentage of the cost of the investment which should be partially divided as profit among the investors. We will now be able to fix a fair price for the electric current from actually realized data.

Let C = cash cost of the plant (say, $2,000,000).

Let N = number of incandescent 16-cp, 110-V. lamps (say, 120,000).

Let z = percentage of profit desired on the investment (say, 15%).

Let p = the price per lamp hour required to realize this (to be deduced).

Let n = annual hours burnt per lamp (to be fixed arbitrarily).

Let F = the fixed annual charges per lamp (about 6.6% of $\frac{C}{N}$) ($1.46 taken).

Let v = the variable hourly charges per lamp (about 21½% of p) (.14c.).

The annual profit on one lamp may be written as follows:

$$p\,n - [\,F + v\,n\,] = z\,\frac{C}{N}$$

Hence

$$p = \frac{z}{n}\,\frac{C}{N} + \frac{F}{n} + v.$$

Let us fix $n = 730$ hours, or 2 hours per day, we have then,

$$p = \frac{15 \times 200000000}{100 \times 730 \times 120000} + \frac{1.46}{730} + 0.14 = \frac{682}{1000}\text{ cent.}$$

Fixing $n = 1460$ hours, or 4 hours per day, we have

$$p = 0.171 + 0.100 + 0.140 = \frac{411}{1000}\text{ cent.}$$

Fixing $n = 2190$ hours, or 6 hours per day, we have

$$p = 0.114 + .067 + 0.140 = \frac{321}{1000}\text{ cent.}$$

Fixing $n = 2920$ hours, or 8 hours per day, we have

$$p = 0.086 + 0.050 + 0.140 = 0.276\text{ cent.}$$

It is not practically worth while to determine a selling price beyond 8 hours at which incandescent electric light can be sold, for reasons already stated. As a matter of interest, 0.276 cent per lamp-hour is equivalent to $0.55 per 1000 cubic feet for 16-candle illuminating gas—rather an astonishing result to reach with 15% profit. It also means 0.617c. per ampere-hour, or, at 110 volts, 5.61c. per kilowatt hour, or 4.18c. per horse-power-hour.

In order to cover dividends on "watered stock" ("capitalized earnings") at any given rate, it is necessary to insert the capitalization of the company in place of the cash cost (C) of its plant in the formula above given. The minimum charge per lamp per year should be: $z\,\frac{C}{N} + F = \$2.50 + \$1.46 = \$3.96$ to obtain 15% profit if discounts are made on long hours' use of current. The station manager, reading these formulae, will at once grasp the fact that almost any reasonable discount from the rates for short hour (say, less than two) burning or use of current will result profitably if given to users of current beyond 2 hours per day.

Another question vexing the station manager's brain is maximum demand. Large office buildings, using light from 4 to 6 p. m. during the winter months and not at all during the summer, require large machinery and conductor investments, and yet, although counting as a large consumer with many lamps, are apt to prove unprofitable. To put in storage cells is usually more costly than to put in the generating machinery to carry their "peak loads." The question of maximum demand has been discussed repeatedly at conventions, but as the maximum demand meters used do not tell when a particular maximum demand occurs, and that is most important, they will hardly appeal to station managers as profitable in evening up the load on the station.

The fixation of two rates, the time of the higher rate of charge

usually being from 5 to 11 p. m., has aroused more interest, and, where results show the station to be unevenly loaded, must be beneficial by obtaining a load at lower rates from 11 p. m. until 5 p. m. the next day. The lower rate should be about one-half the full rate for light and power, or less, as daylight loads are usually motors and lamps burning in dark rooms all day.

The elevator motor in business hours shows very poor returns and should have a minimum rate per horse-power per year, as perhaps should all others. Reducing in the present example to lights at 15 to the horse-power, we have for 1 horse-power

$$z\frac{C}{N}+F=\frac{15}{100}\times\frac{15\times 2000000}{120000}+15\times 1.46=\$59.40.$$

There are no lamps to be renewed with motors, so this result is a little in excess.

Assuming F at $1.46 instead of $1.10, theoretically right, operates to keep the manager on the safe side in all cases heretofore discussed. This prudence should control him in all cases until such time as results verify his reasoning, when he can take another step forward. There is nothing like an experiment to destroy incorrect theories and superficial reasoning. The prices and profits obtained from the data and the formula have been bitterly denied by interested parties, yet the writer vouches for the accuracy of his numerical data and the cash payment of large earned dividends.

To make another trial of the formula, let us suppose the capital stock and bonds on a $2,000,000 plant to be increased to $10,000,000, and the task assigned to the manager of earning 10% on this amount, the station remaining as it is. For 2 hours per day average burning

$$p=\frac{10\times 10,00000000}{100\times 730\times 120000}+\frac{1.46}{730}+0.14$$

or 1.140 + .200 + 0.140 = 1.48c. per lamp hour.

This is the result of watering the capital stock to the extent of $8,000,000. The manager must raise prices if the public will stand it. If we deem 5% sufficient profit on $10,000,000 capital the price must be 0.910 cent for full rates instead of 0.682 cent per lamp hour on cash value. Thus we have the spectacle of promoting financiers loading down the company with fixed charges, or demands, and the managing engineer struggling to reduce the variable charges so as to pay this demand for dividends. Is it any wonder that he frequently fails to give satisfaction under such impossible conditions?

A young mechanical engineer recently told the writer of his purchase of a 3600-light alternating current plant in a village. This plant was practically a wreck and losing money on a flat rate. Everybody connected with it was so discouraged that no money was spent on it, and breakdowns almost every night for hours passed unnoticed. He bought the plant for $27,000 and spent $3000 more on it, making a total of $30,000. The original cost was considerably more. An overhead system was used because distances were so great.

He did what every manager should do, stayed with his plant all the time, and soon there was an end to breakdowns, as he had thoughtfully anticipated all contingencies. He introduced meters, and getting the old machinery and boilers into good economical operating shape, reduced the variable expense to 1½ mills per lamp hour. His fixed expenses were $7000 and his profits $9000 the first year.

The price for which anything must be sold contains three factors:

(1) The annual profit on the cost of the original investment per article made $\left(\frac{z}{n}\frac{C}{N}\right)$ and sold.

(2) The fixed annual expense per article made $\left(\frac{F}{n}\right)$ and sold.

(3) The variable expense per article made (V) and sold.

We have for the number of lamp hours annually sold at ¾c. per 16-cp lamp hour, for each lamp attached.

$$n=\frac{z\frac{C}{N}+F}{p-v}=\frac{250+243}{0.75-0.15}=821.66.$$

The average daily burning of the lamps on this station appears to be 2¼ hours.

The case of an arc light station is somewhat different, but the same method of reasoning applies. The arc lights usually are all in use for ten hours per day, and the machinery and power capacity of the station must equal the full load.

For commercial purposes we can say that a 2000-cp arc light takes 55 volts and 10 amperes—550 watts. If, for example, we take a most perfectly appointed 1000-hp city plant, its cash cost ready to run should not exceed $250,000 *(C)* and its fixed expenses $15,000. Assuming 1000 arc lamps the fixed annual expenses per lamp are $15.00 *(F)*. The variable hourly expenses per lamp (550 watts) are 1.54 cents. Assume 15% *(Z)* as a fair profit on the capital invested and 3650 *(n)* hours per year per lamp burning. Then

$$p=\frac{15}{100}\times\frac{1}{3650}\times\frac{25,00,0,000}{1,000}+\frac{1500}{3650}+1.54=2.979 \text{ cents.}$$

we have

Profit per lamp-hour per lamp	1.028 cents
Fixed expenses per lamp-hour per lamp	0.411 "
Variable expenses per lamp-hour per hour	1.540 "
	2,979 cents

For ten hours per day the price should be 30 cents, or $109.50 per year. The varying cost of coal and of power as well as cost of construction of plant will affect this result; but this is a fair price for series arc lights from a first-class steam plant. Where stations are engaged in delivering power along with light, the fixation of prices per horse-power hour can be made in a similar manner.

In hydraulic power plants, where coal is eliminated and nothing is paid for the water, the variable expenses (v) almost disappear and the price becomes a question of fixed expenses per lamp-hour per lamp $\left(\frac{F}{n}\right)$ and of profit on investment per lamp-hour per lamp $\left(\frac{z}{n}\frac{C}{N}\right)$ This is the advantage of water power, and the only advantage. Sometimes it will be found cheaper to generate power by steam in near-by stations rather than to make a vast investment in dams, hydraulic machinery and transmission plant.

The reader can, with little effort, adapt the generalizations of the writer and determine under all possible conditions the feasibility of a hydraulic plant. In the case of electric railways the car-hour (not the car-mile) should be the unit used.

The Susquehanna Electric Power Company proposes to dam the Susquehanna at a cost of $7,000,000, obtain 80,000-hp by so doing, and sell this power to users within accessible distances. It will be of interest to determine the price per horse-power hour at which this company can sell power, assuming that $7,000,000 will be the total investment covering machinery and transmission plant.

We assume the annual fixed expenses at $450,000 and that ten hours in twenty-four are the average hours of use of power. The variable expenses we assume to disappear and the profit desired to be 15% on the investment. The investment is $87.50 per horse-power. The price *(p)* per horse-power hour will be for $n=3650$ hours; when 80,000 horse-power have been marketed and not till then

$$p=\frac{z}{n}\frac{C}{N}+\frac{F}{n}=0.360+0.154=.514 \text{ cent per H.P. hour,}$$

or 5.14 cents per day or $18.76 per year. The Niagara Falls Power Company are said to be selling power at $20 per year per horse power. It seems to be a wisely managed enterprise and is prospering. Of course, a steam-generated horse-power cannot profitably be sold at this price.

If any one will stand on the roof of a high building in a great city he will see hundreds or thousands of exhaust pipes throwing out jets of steam beside a chimney which vomits smoke or gas and ashes. Each one of these means a steam plant, which should not exist, for all the power required can be supplied at a profit and more cheaply from a great electric plant, and all the heat required can profitably be furnished for less than the cost of coal required for it in the form of water gas.

The city would be clean and the air clear and pure; no coal would come to our doors, and, being dumped into our cellars, fill our houses with dirt and ashes. Why has not this been done? It can be done and has been done in the past and it would be done now, were it not for the measureless avarice of men who through political influence obtain municipal franchises amounting to monopolies and then extort enormous profits from powerless citizens, covering their tracks by paying small dividends on inflated capitalizations.

The vast electric trusts which are being organized throughout the United States may not, and probably will not, raise prices, nor can they reduce fixed expenses to any extent, although it is the pretext for their organization. They maintain prices in most cases, however, and they get the advantage of the immense reduction in cost of production which arises from the almost incredible increase of volume of business everywhere in this country.

The promoters always provide for the division of the amazing

profits resulting by issuing millions of stock and selling it to "innocent parties." This is nothing more than a legalized "gold-brick game." If these "innocent parties" would be careful to see that the capitalization of a company did not exceed the cost of its plant before purchasing a stop would be put to "get rich quick schemes" and prices would fall with healthy competition. The writer may be pardoned, he trusts, for saying that a corporation capitalized only to the extent of its cash investment, restricted to a fair dividend of about 8 per cent. and a reserve of 7 per cent. for large renewals and repairs, is a beneficent institution. Its management should be honest and able and its prices to the public reduced as larger business brings down the cost of production—the dividends remaining constant. Such an ideal, however, seems too Utopian for realization to-day. Municipal plants in the hands of citizens of public spirit and probity are our only hope.

The company which has served our purpose as a basis for computation was steadily engaged in earning big dividends and reducing prices to consumers and the city, when its board of directors for business reasons (several of them were subscribers to the purchasing company) sold it to another company, and since then it has twice been sold again.

Now its modest cost of two or three millions is represented by about 10 or 15 millions in bonds and preferred and common stock, and none of the three purchasing companies (two have been swallowed by successors) has ever made a frank showing of earnings. When competition does get a foothold "innocent parties"will have a lot of valueless stock and deserve no sympathy. Of course, no manager can earn a dividend on a tenfold watered stock honestly. All of these commercial phases of electric lighting may appear of little value to the reader interested only in scientific work but to the *Station Manager*, for whom this paper is written he trusts it will be of interest and value, as covering the ground upon which he is placed, and perhaps clearing up the situation enough to tell him whether he can hope to earn dividends at fair rates for light and power.

Gas Coke for Electric Lighting.

Alton D. Adams.

COAL gas manufacture results in the production of about 1300 pounds of coke and 10,000 cubic feet of gas from each ton of good gas coal carbonized. Allowing 300 pounds of coke to carbonize each ton of coal, leaves a net coke product of 1000 pounds per 10,000 feet of gas produced. The market value of this coke is usually less than one-half of the cost of the coal from which it is obtained, and the best method for its utilization has long been a live question with gas companies. To offer coke for general fuel purposes, at prices that insure its use, is thought by many gas managers to impede the expanding and desirable use of gas in heating operations. Methods of coke consumption at coal gas works have therefore the advantage that coke is kept out of the fuel market.

The very extended introduction of water gas manufacture, at coal gas works, during the past few years, has no doubt been due in part to the desire to consume the main body of the coal used, rather than to send one-half of it out as solid fuel. There are some reasons, however, that make it in many cases undesirable, at a coal gas works, to utilize the net coke product for the manufacture of water gas. Some of these reasons are the amount of coal gas apparatus to be put out of use, the increased investment in plant without material increase of revenue, the moderate per cent. of the energy from coke that may be transferred to water gas, and the manufactured cost of carburetted water gas compared with that f coal gas.

Take, for instance, a well-equipped coal-gas plant with sufficient capacity for present requirements, that wishes to consume its own coke. Allowing forty pounds of coke for consumption under steam boilers and in water-gas generators, per one thousand cubic feet of carburetted water gas produced, which nearly corresponds with the best practice, 1000 pounds of coke are sufficient for the manufacture of 1000 $(1000 \div 40) = 25{,}000$ cubic feet of carburetted water gas. As the entire gas output of the coal-gas works is only 10,000 cubic feet of gas per 1000 pounds net of coke produced, the coal gas is only $10{,}000 \div (10{,}000 + 25{,}000) = 28.5$ per cent. of the combined coal and water-gas product. This means that nearly three-fourths of the equipment for the manufacture of coal gas must be put out of use, and new equipment of equivalent capacity set up to produce water gas, if the entire excess of coke is to be consumed for water gas production. The coal gas equipment thus displaced can be sold for only a small fraction of its original cost, and, unless the consumption of gas by the public can be increased, or a saving in the cost of manufacture made by the water-gas process, the same net earnings must pay dividends on a larger investment.

An investigation of the relative costs of coal and water gas is beyond the limits of the present paper, but it may be said that, in the opinion of many, carburetted water gas offers at most no advantage in manufactured cost over coal gas, with gas oil at present prices, and the dividends that are being paid by some coal gas companies tend to strengthen this view. So far as any material increase of business from the introduction of water gas is concerned, it would be a trifling matter. The total cost of coal to a gas company thus changing from coal gas to mixture of coal and water gas, is thus reduced about 70 per cent. by the change, but this saving is nearly offset by the cost of gas oil to carburett the plain water gas. Residual products from the changed plant are greatly reduced in amount and value, thus more than counteracting any gain in the value of coal saved over the cost of gas oil.

It appears therefore, that the coal-gas plant, having added enough water gas apparatus to consume all of the coke, has a larger investment, a slightly less income and about the same cost of manufacture, as to materials. The labor of manufacture will be somewhat reduced, but the increase of interest and fixed charges will largely offset the saving in labor. Remaining as the only substantial advantage is the fact that coke no longer competes with gas in the local fuel market. What this advantage is worth does not concern the present argument, since the other method here proposed, for the consumption of coke, has the same effect in this particular.

While the substitution of water gas apparatus in a gas plant has a tendency to contract the operations of the gas company by reducing the sum total of their salable products, the addition of an electrical generating equipment at the gas plant greatly increases its field of operations. It is true that electrical energy is, to some extent, a competitor with gas, but it is a competitor that gas must meet, and it is certainly not more dangerous when controlled by the gas company than when in the hands of opposing interests. Electric light and power will be largely used in every community, whatever the attitude of gas companies toward them, and they will bring the most profit to those best situated for their economical production and distribution to consumers.

In order to compare the values of the gas and of the electric energy that may be derived from coke with each other, low prices, such as hold for some large cities, may be assumed for each. Assuming a price of $1.00 per 1000 cubic feet for carburetted water gas, and ten cents per kilowatt hour for electrical energy, fairly represents their costs to consumers. One thousand cubic feet of carburetted water gas, containing 700 heat units per cubic foot, has a composition by volume of nearly 65 per cent. pure water gas and 35 per cent. oil gas. As one cubic foot of pure water gas has a capacity to develop about 325 heat units, the 650 cubic feet per 1000 of carburetted water gas, have a capacity of $325 \times 650 = 211{,}250$ heat units, or only $211{,}250 \div 700{,}000 = 30$ per cent. of the total heating power of the carburetted gas. Considered as to the energy of the coke consumed in the manufacture of carburetted water gas, the heating power of the pure water gas is found to be $211{,}250 \div (13{,}000 \times 40) = 40$ per cent. of that in the coke at 13,000 heat units per pound. Allowing for the pure water gas, in each foot of carburetted gas, that portion of the selling price, which its energy is of the total energy per cubic foot, gives the pure water gas from 40 pounds of coke a value of thirty cents.

Gas producers can now readily be had that yield a gas having 80 per cent. of the total heat energy in coal, and good gas engines of moderately large capacity transform and deliver fully 20 per cent. of the heat from gas combustion to connected machines. Electric generators easily show an efficiency of 90 per cent., so that the gas producer, engine and dynamo combination deliver as electric current, $.80 \times .20 \times .90 = 14.4$ per cent. of the energy of coke. Forty pounds of coke, at 13,000 heat units per pound is, therefore, competent to deliver the equivalent of $13{,}000 \times 40 \times .14 = 72{,}800$ heat units at dynamo terminals. One kilowatt hour being the equivalent of 3412 heat units, the output of electrical energy from forty pounds of coke amounts to $72{,}800 \div 3412 = 21.3$ kilowatt hours. The value

of this output at ten cents per kilowatt hour is $21.3 \times .10 = \$2.13$, or $213 \div 30$, or 7 times the value of the same amount of coke in carburetted water gas.

The gas with which the forty pounds of coke are concerned is worth $1, but .7 of the heating and a larger part of the lighting power of the carburetted gas are derived from oil, which must be provided in addition to the coke. True it is that some of the heat from the coke is used to volatilize the oil and fix the gas, but this is sensible heat that would otherwise escape unused.

From the above it appears that coke used to generate electric energy is seven times as valuable a product as when consumed to make water gas, and that electric current generated from the coke alone, is more than twice as valuable as is the carburetted water gas produced by an equal amount of coke and about five gallons of gas oil.

Coming to the question of investment for an existing coal-gas plant, the introduction of carburetted water-gas equipment to an extent that will consume all of the coke subsequently produced, involves a capacity, in water-gas equipment, equivalent to 72 per cent. of the present coal-gas output, and a displacement of a corresponding capacity of coal-gas apparatus. If gas producers, engines and dynamos are installed with sufficient capacity to consume all of the coke made at a coal-gas plant, the gas producers must be competent to gasify 100 pounds of coke for each 1000 cubic feet of coal gas from the ovens. To change the heat of the gas from this 100 pounds of coke, except losses, into electric energy, requires gas engine and dynamo capacity of $\frac{100}{40}$ $(21. \div 10.5) = 5$ kilowatts, on the basis of 10.5 hours' operation at full capacity, during each 24 hours. The equipment for the production of electric energy will displace none of the coal-gas apparatus. The water-gas apparatus leaves the gross revenue from the sale of gas as before, but adds nothing to it to offset the increased fixed charges. The electric plant also leaves untouched the revenue from the sale of gas, but adds a much greater revenue to it, provided the entire production of coke can be consumed for electric service. As forty pounds of coke generate 21.3 kilowatt hours of electric energy at dynamo terminals, the 100 net pounds of coke, available from the coal-gas plant for each 1000 cubic feet of coal gas generated produce $(100 \div 40) \times 21.3 = 53$ kilowatt hours. At ten cents per kilowatt hour, the value of this electric energy from 100 pounds of coke is $5.30, or more than five times the value of the coal gas of which this amount of coke is a by-product.

The query at once suggests itself, whether a coal-gas plant will probably find a market for all the electric energy that its coke can generate? An answer to this must depend to some extent on local conditions, but may be found in part from the present consumption of electric energy and gas. Inspection of the accounts of quite a number of gas and electric companies in cities of from 25,000 to 100-000 population each, shows that the gross return for electric energy is, on the average, approximately equal to that for gas in each city. This fact clearly indicates that at present prices for electric energy, the entire production of coke at coal-gas works cannot be consumed for the general distribution of electric current.

The large amount of energy now required for the operation of electric street railways, and the present tendency to combine machinery for lighing and traction purposes at a single plant, should be held in mind, when the probable amount of future electric loads is considered. A gas company is frequently in a position to avoid much of the fixed expense that must be incurred for the supply of electric energy by an independent company. Items along this line are those for real estate, fuel to some extent, and office expenses. If these advantages enable a gas company to reduce current prices for electric current, a material increase in its use is sure to follow. Finally, the control of gas and electric service by one management will surely tend to the more extended application of each to those purposes for which it is best adapted.

Municipal Telephone System In Chicago.

It is stated that a municipal telephone system is to be establishen in Chicago. Its immediate use is to be confined to the Police and Fire Departments, but its projectors say that eventually it will serve as the nucleus of a great metropolitan system. Rates sufficiently low to make the telephone a cheap convenience are predicted by those who see a great future in the municipal plant.

Third Rail Sectioning on Metropolitan Elevated, Chicago

The method of sectioning the third or trolley rail which has been in use on the Metropolitan Elevated Railway of Chicago for a number of years, but which has never found its way into print, is illustrate by the accompanying diagram. Dividing a trolley wire into sections insulated from each other is a comparatively simple matter requiring nothing more than a section insulator of sufficient length so that the trolley wheel can not bridge across the two sections. On elevated railroads the custom of having a contact shoe at both ends of the car makes it impractical to get along with nothing but a simple section insulator between the third rail sections.

For example, if a short circuit occurs on one section and the circuit breaker on that section opens, then a motor car running onto that section from an adjoining one will connect the dead and short circuited section with the live one next to it, because the contact shoe on one end of the car is momentarily on one section and that on the other end of the car is on the other section, and the shoes are connected in multiple. The live section is therefore short circuited also, a contingency which it is best to avoid.

To prevent the current supply on one section being interrupted in

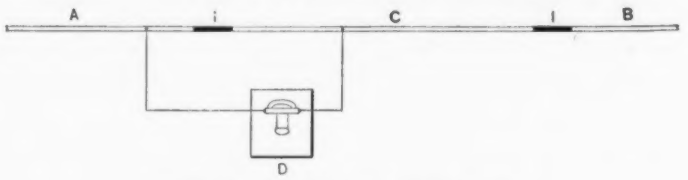

DIAGRAM OF THIRD RAIL SECTIONING.

this way by trouble on adjoining sections, a short section of third rail is put between the two main sections. This short section is insulated from the two sections on each side of it and is fed through an automatic circuit breaker from one of the adjoining sections. This short section is made slightly longer than a car. In case the motor car runs from a live to a short circuited section the circuit breaker opens and no further damage is done. Meanwhile the road can operate on the live section and full traffic can be resumed as soon as the grounded section is clear. It is not even absolutely necessary that the circuit breaker supplying the short section be closed at once, because trains can drift over it if necessary.

In the diagram, *A* represents the end of one long section of third rail and *B* the adjoining end of another long section. *I* and *I* are section insulators and *C* is the auxiliary section which is made about a car length, or a little more than the distance between contact shoes. The circuit breaker *D* is in the circuit supplying section *C* from section *A*. If either *A* or *B* is grounded circuit breaker *D* will open if a car bridges across between *B* and *C*.

Purdue University Lectures.

Mr. A. V. Abbott, of the Chicago Telephone Company, on April 25, lectured before the engineering students of Purdue University on "The Construction of Electrical Distribution Circuits." This is Mr. Abbott's second visit to the University, his last lecture being on "Wireless Telegraphy," during the spring of 1899, at which time he gave a most valuable and interesting presentation of his subject.

Engineering Lecture at the University of Illinois.

The following named lectures, by non-resident engineers, have been scheduled for the year 1899-00 and six of them have been delivered. Mr. Walter B. Snow, of the B. F. Sturtevant Co., Boston, Mass., on "Mechanical Ventilation and Heating." Mr. H. G. Prout, editor of the *Railroad Gazette*, on "Engineers and the Railroads." Mr. A. V. Abbott, Chief Engineer of the Chicago Telephone Co., on "Electrical Highways." Mr. F. W. Wilcox, of the General Electric Co., Harrison, N. J., on "The Evolution and Economic Use of Incandescent Lamps." Mr. F. H. Newell, hydrographer, United States Geological Survey, Washington, D. C., on "Hydrographic Work of the United States Geological Survey," and on "Reservoir Surveys along the Gila River, Arizona." Mr. W. A. Layman, of the Wagner Electric Manufacturing Co., St. Louis, Mo., on "Transformers in Modern Electric Power Transmission." Prof. R. B. Owens, McGill University, Montreal, Canada, on "Most Recent Developments in the Applications of Electricity."

A Millions Dollars for Electric Light Plants at Colorado Springs.

By J. W. Dickerson.

WITHIN the next few months two large electrical plants will be built at the coalfields north of Colorado Springs, Col. In the last few years the coal mines have been developed to a considerable extent and their value has been amply demonstrated. The location of the power station at this point insures an abundance of good and cheap fuel. Both companies will engage in vigorous competition with each other for the electric light and power business in Colorado Springs and Colorado City, and cheaper rates than those now prevailing are inevitable. The cheap supply of power will make Colorado City a manufacturing point of great importance.

The current for light and power has, up to the present, been furnished by the El Paso Electric Company, but the company has been recently taken over by the Colorado Springs Electric Company, organized to develop and enlarge the business. William P. Bonbright & Co., and William A. Otis & Co., of Colorado Springs, successfully promoted the company, and with Bertron & Storrs, of New York, disposed of the necessary stock at par to the amount of $700,000. The company organized with the following officers: President, William A. Otis; vice-presidents, William P. Bonbright and S. Reading Bertron; secretary and treasurer, Irving W. Bonbright; directors, William A. Otis, William P. Bonbright, S. Reading Bertron, Irving W. Bonbright, J. A. Hayes, James F. Burns, R. J. Bolles, F. H. Morley, P. B. Stewart, L. E. Curtis, Henry Hine, C. E. Palmer and J. P. Pomeroy. The majority of the stock was taken in Colorado Springs, and local directors will have control in the board.

The plant now owned by the company, with a capacity of 1600-hp, will be abandoned after a new power station is built, and will be held as a reserve in the case of emergencies. The new plant of the company will be established in the coal district north of the city, where coal lands have been leased and where the fuel supply will be unlimited and cheap. The Curtis Coal Company has also contracted to deliver a supply at this point at a reasonable price. In building its power station and in improving and enlarging its facilities of all kinds the corporation will expend $700,000, and everything will be of the best and most modern type. It is proposed to use dynamos of 1000-hp each, and at the outset two and possibly three machines of this capacity will be utilized. The general manager of the company, who has recently assumed his duties, is Mr. Henry Hine, formerly general manager of the Stanley Electric Company, of Pittsfield, Mass., and previously identified with the Westinghouse Company. He is now in the east engaged in the purchase of machinery; no expense will be spared in this respect. Upon his return work will be commenced on the buildings, and they must be completed so that operation will start in next December. It is necessary to finish the work at this time, as the company has contracted to supply with power then the works of the Standard Milling & Smelting Company, which will have a three-quarter-million plant at Colorado City. It is probable that the Colorado-Philadelphia Reduction Works, of Colorado City, will also be supplied with 1000-hp.

The Standard Milling & Smelting Company, just referred to, was recently organized by those identified with the Colorado-Philadelphia Reduction Company. It has just awarded to the Edward P. Allis Company, of Milwaukee, Wis., the contract for its machinery, with the exception of the gas producers, electric power plant, concentrators, dust chambers and stacks. It was one of the largest contracts ever taken by the Allis Company. The machinery will weigh 2,000,000 pounds, and eighty freight cars will be needed to carry it from Milwaukee.

On April 3 the franchise of the Citizens' Heat, Light & Power Company was confirmed at the city election. Under the law all franchises after being passed by the city council must be approved by the citizens. The company gained its privilege by a vote of about twelve to one. The award of the franchise means the introduction of a new factor in electric lighting and power in Colorado Springs. Heretofore the El Paso Electric Company has controlled the supply of current for these purposes in Colorado Springs. The Citizens' Company will compete actively for the business, and citizens are likely to have smaller bills in the future. The company also expects to make a special point of supplying electricity for heating, as its name indicates.

The power station will be built in the coal district three miles north of the city limits. By the aid of automatic stokers it will be possible to use the coal at this point with very little labor. The company will take coal from either the Carleton or Pikes Peak mine, and will make payment for fuel by furnishing the mines with power, a plan that will work to the economy and advantage of both plants.

The manager of the company is Mr. E. E. Wade, who for thirteen years has been the general manager of the El Paso Electric Company, and in that capacity was a most successful official. In order to secure the machinery Mr. Wade and Mr. L. L. Aitken have gone east, and will purchase the best possible equipment. It is thought that thirty-five cars will be required to carry the load to its destination.

It is planned to start the plant during the last of next October, and the station will then have a capacity of 1500-hp. An important part of the load will be the supply of power to smelters in Colorado City for crushers and concentrators. The use of electric power is looked upon with great favor, as smoke is avoided, and the utmost reliability may be depended upon.

J. R. McKinney will be president of the company, and those principally identified with the enterprise are the following: L. L. Aitken, E. E. Wade, Bert Davie and R. R. Taylor. A number of the most prominent moneyed men of the city are also interested in the company.

Annual Report of The General Electric Company.

The report of the General Electric Company for 1900 is prefaced by a feeling tribute to the late Charles Henry Coster, a director and member of the Executive committee, in the form of a resolution of the Board of Directors.

REPORT OF PRESIDENT COFFIN.

The report of President C. A. Coffin commences with a reference to the rapid growth of confidence during the past year in the securities issued by electric railway, illuminating and power companies, and a greatly increased investment demand therefor. The result of this employment of new capital in such enterprises has been to stimulate the production of that class of electrical apparatus to the manu facture of which the factories of the General Electric Company have been largely devoted.

Apart from the activity in such fields, the rapid adoption of electricity for operating all kinds of machinery, its application in naval and marine service, and to chemical uses, and the introduction of eicctric street vehicles, have resulted in the design and manufacture of many new electrical appliances by your Company. Meanwhile the demand for those motors, lamps and general supplies, which have long been standard with your Company, has been well maintained.

President Coffin gives the following resumé of the statements included in the report:

The profits for the year (including an unusually large profit, amounting to $838,857.73, derived from the sale of securities), after deducting all general, patent and miscellaneous expenses, expenditures on factories and allowances for depreciations and losses, were $5,479,130.20. Subtracting dividends on preferred and common stock, and interest on debentures, amounting to $1,282,670.67, and reduction in patent account of $2,000,000, leaves a net addition to surplus account of $2,196,459.53.

It is stated that while the results of the year's business have in general been satisfactory, the wide fluctuations in the values of raw material have created much disturbance and increased the difficulties in estimating costs and in fixing prices. Because of the complexity of its business and the great number of devices manufactured by the company, aggregating many thousand separate items, every revision of values adds very heavily to the burdens of those in charge of the manufacturing department. In conclusion the arduous and admirable service rendered by the engineering and commercial departments are highly commended.

REPORT OF FIRST VICE-PRESIDENT.

The report of Gen. Eugene Griffen, shows that for the fiscal year ending January 31st, 1900, the total sales (amount billed to customers) were $22,379,463,75, and the cost of goods sold, general expenses, taxes, depreciations, losses and allowances for losses $18,573,-603.57, leaving a profit on sales of $3.805,860.18.

It is noted that the "Profit on Sales" is figured independently of

various items on the profit and loss statement the aggregate of which is a credit balance of $1,673,270.02, making the total net profits $5,479,130.20.

The increase over last year in orders received is 51%. The increase in each class is:

Apparatus orders	67.4%	over last year.
Supply orders	38.0%	" " "
Incandescent lamp orders	34.2%	" " "

Over 142,000 separate supply orders were received, of which only 623 were in excess of $1,000, the average of all being $59.00. Over 10,000,000 incandescent lamps were ordered during the year. There were 11,807 customers on the books at the close of the fiscal year. About 87 per cent. of the year's orders were on the standard terms of payment—cash within sixty days.

Following is a comparison of the orders received for the past five years:

Fiscal year ending January 31, 1896	$13,235,015
" " " " " 1897	11,170,319
" " " " " 1898	14,382,342
" " " " " 1899	17,431,327
" " " " " 1900	26,323,626

The local office inventories have been increased $180,031 during the year and are maintained in good salable condition. The recent inventory shows:

Active	$635,478.00	96.6%
Inactive	18,853.00	2.8%
Obsolete	3,723.00	0.6%
Totals	$658,054.00	100%

The past year shows a very large increase in volume of business over any previous year, due in part to much higher prices caused by the very considerable increase in cost of raw materials. The policy of consolidating small lighting and railway companies and substituting one large generating plant for two or more small ones has been continued and has caused a marked change in the character of electrical apparatus now being purchased. Large polyphase generators with alternating current distribution and rotary converter substations are almost exclusively used in such consolidated stations when the transmission covers considerable distances.

It is stated that the great increase in orders (51%), has involved an increase of 14½% in the expenses of the sales department, and has necessitated more and harder work on the part of all department and local office managers and sales agents. Vice-president Griffen has high praise for these, stating that it would be difficult to find a more loyal, hard-working and faithful corps of employees than is to be found in this department, and he expresses his great appreciation of the energy, zeal and loyalty shown by them during the past year. Referring to the late S. Dana Greene, general sales manager and chairman of the local companies committee, he says his death is not only a serious loss to the company, but also a personal bereavement to all of his friends and associates in the company.

REPORT OF THIRD VICE-PRESIDENT.

The report of Mr. E. W. Rice, Jr., relates to manufacturing and engineering for the fiscal year ending January 31st, 1900.

The usual practice of billing the output of the works to the General Office at estimated factory cost has been continued. This cost includes all material and labor, plus a percentage to cover all items of general manufacturing expense and engineering, and an ample allowance for depreciation. The percentages thus added to material and labor is stated to have been demonstrated by the annual inventory to be sufficient, as may be seen by reference to the financial statistics given in the report of the second vice-president.

The great increase in orders has strained the factory facilities to the utmost notwithstanding the liberal additions heretofore made to machinery and buildings. The large new machine shop lately added to the plant is now crowded with work.

There have been erected at the Schenectady works during the past year a forge shop of 16,000 sq. ft. and a storage building of 12,000 sq. ft. Additions aggregating about 55,000 sq. ft. have also been made to the drafting room, pattern shop, punch press shop and brass foundry, all substantial buildings of brick and iron construction. The large iron foundry which was completed about a year ago has been found inadequate, and an extension of about 40,000 sq. ft. is now under way. An extension to building No. 23, of about 40,000 sq. ft. has been started. This is needed to take care of the increased demand for switchboards, controllers, and similar apparatus.

At the Lynn works there has been completed a further extension to the steel foundry, of about 18,000 sq. ft. The new building for the manufacture of meters and instruments, mentioned in last year's report, is now so crowded that a further increase of 7,000 sq. ft. has been found necessary and is now under way. Fourteen acres of land have been purchased at the River Works, at Lynn, in order to give room for future extensions.

At the Harrison works the large fire-proof building, mentioned last year, has been completed and is in full operation, and further extensions are under consideration in order to give the needed increase in our output.

The total area of the factory buildings aggregates approximately 2,000,000 sq. ft., which will be increased 100,000 sq. ft. when the buildings now under way are completed. The number of employees in all the works is about 12,000.

During the past year there was expended for new buildings, extensions and machinery equipment, a total of about $900,000, exclusive of the expenditures for patterns, special tools, furniture, etc.

The engineering work during the past year is stated to have been chiefly in the direction of improved efficiency and overload capacity, and in the design of larger sizes of apparatus of existing types.

A number of the great electric generators (500 h. p.) for the new station of the Metropolitan Traction Co., New York, have been in operation for several months and are regularly supplying current for the operation of electric street cars and for lighting in the City of New York. Eight machines of the same general character, are now being made for the new station of the New York Gas, Electric Light, Heat & Power Co., of New York City, to be used for the generation of current for lighting and power purposes, aside from electric street railways.

There has been a marked increase in the size of electric generators, of the direct current type, suitable for lighting and power for moderate distances. Long distance transmission plants have increased in number and importance during the past year.

The revolving field type of alternating generator with stationary armature winding permitting the direct generation of electricity at high potentials has met with great success and is now generally employed to the exclusion of older and less perfect types. Orders during the year for this type of generator alone amounted to over 200,000 horse power.

There have been sold during the year about 150,000 h. p. of large transformers of the air blast type, a design introduced and supplied solely by us. The United States Navy has generally adopted electricity in place of steam or hydraulic machinery for pumping, hoisting, ventilating, and operation of turrets, as well as for lighting and small power work.

There has been a continued increase in the number of electric motors used for driving machine tools in factories, and in such special applications as the operation of printing presses, ventilating, pumping, mining, cotton mill and paper mill machinery.

Many important orders, covering all classes of our apparatus, have been filled for foreign countries.

There has been a marked increase in the demand for electrical apparatus of special design, which is more expensive than standard, takes longer to produce and diminishes the effective output of the works. To meet this demand the line of standard sizes is being systematically increased, which can be produced of superior quality in shorter time and sold at a lower price.

There has been a continued improvement in the efficiency and quality of the numerous small articles of manufacture, such as arc lamps, transformers, and particularly, switchboards. New and important engineering designs have continued to be protected, as far as possible, by applications for letters patent.

SECOND VICE-PRESIDENT'S REPORT.

The report of second vice-president J. P. Ord includes the accompanying balance sheet, and explanations of its various items.

Patents, franchises and good will were carried in the last annual report at $4,000,000. During the year there were expended for acquiring new patents, in patent expenses and patent litigation, $353,333.87, leaving the total patent account before closing the books, $4,353,333.87. By vote of the directors there was charged to profit and loss, as of January 31, 1900, one-half the then book value of patents, or $2,000,000, and all patent expenses of the year, $353,333.87, making a total of $2,353,333.87, thus leaving all the patents, franchises, good will, etc., of the company standing on its books at the date of this report, at $2,000,000.

The factory plant account represents the real estate (lands and buildings); machinery (steam plants, tools, appliances, etc.); patterns (including drawings, etc.); and sundries (fittings and other small property accounts) of the manufacturing plants at Schenectady, New York; Lynn, Massachusetts; and Harrison, New Jersey. All are free from mortgage or other lien.

The lands of all three plants now amount to about 174 acres and the total factory floor space of all their buildings is approximately 2,000,000 square feet. It is worthy of note that the entire book value ($1,858,044.65) of all lands and buildings is less than one dollar per square foot of the total manufacturing floor space in those buildings.

The company's constantly growing business has necessitated continuous expenditures to increase its manufacturing capacity by acquiring more land, enlarging old and erecting new buildings and for general improvements and new machinery. The cost of these additions has been charged against the general earnings of the company, as have also all expenditures for the maintenance and repair of buildings and machinery, plus an allowance to provide for depreciation.

On January 31, 1893, the book value of all three factory plants was $3,958,528.21. In the fiscal years 1891 to 1899—both inclusive—additions of lands, buildings, machinery, etc., have been made at a total cost of $4,560,863,09. During those seven years there have been written off to provide for depreciation on these plants, $5,119,389.30, thus leaving their book value on January 31. 1900, $3,400.02, divided as follows: Schenectady plant, $2,300,000.90; Lynn plant, $900,000.80; Harrison plant (lamp factory) $200,000.30.

A summary of the changes in this account since the last annual report is as follows:

	Book Value Jan. 31, 1899.	Cost of additions during the year.	Written off at the end of the year.	Book Value Jan. 31, 1900.
Real Estate,	$1,857,044.65	$390,327.12	$389,327.12	$1,858,044.65
Machinery,	1,542,955.35	650,633.00	651,633.00	1,541,955.35
Patterns,	1.00	161,157.42	161,157.42	1.00
Sundries,	1.00	128,310.86	128,310.86	1.00
Totals,	$3,400,002.00	$1,330,428.40	$1,330,428.40	$3,400,002.00

Real estate other than factory plants consists of the investment in the Edison Building, 44 Broad Street, New York City; also a four story brick building covering five lots on the corner of Avenue B and 17th Street, New York City; and sundry parcels of land in various places, mostly improved and rented, which have been acquired at various times, chiefly in payment of debts. All are free from mortgages and will be sold when opportunities offer. This account has decreased $51,391.28 during the year, chiefly by selling real estate in Atlanta, Ga., and Rock Island, Ill.

Pursuant to the established policy of selling securities which there is no special reason for holding permanently, various stocks and bonds have been sold for cash since the last annual report. Their total par value was $2,755,518.05; they were sold for $2,678,409.03, and had been carried on the books at $1,839,551.30, thus leaving a profit of $838,857.73.

The money realized from the above sale of assets was expended upon extensions to the factory plants, in purchasing $400,000 of the company's own debentures and to protect and improve existing investments by acquiring (at a cost of $1,274,428) miscellaneous stocks and bonds, of the aggregate par value of $1,693,400.

In the book valuations of stocks and bonds remaining on hand since January 31, 1897, no material changes have been made since

BALANCE SHEET OF JANUARY 31, 1900.

ASSETS.			
Patents, Franchises and Good Will			$ 2,000,000.00
Factory Plants			3,400,002.00
Real Estate (other than factory plants)		$ 563,643.44	
Stocks and Bonds		6,132,268.04	6,695,911.48
Cash			1,537,071.86
Notes and Accounts Receivable		6,978,002.30	
Work in Progress		874,128.36	
		7,852,130.66	
Inventories—			
Factories	$ 7,264,666.01		
General and Local Offices	737,580.23		
Consignments	45,334.85	8,047,581.09	15,899,711.75
			$ 29,532,697.09

LIABILITIES.			
Capital Stock			
Seven per cent. Cumulative Preferred		$ 2,551,200.00	
Common		18,276,000.00	$ 20,827,200.00
5% Gold Coupon Debentures			5,300,000.00
Accounts Payable		1,003,364.05	
Accrued Interest on Debentures		44,166.67	
Unclaimed Dividends		4,935.85	1,052,466.57
Profit and Loss			2,353,030.52
			$ 29,532,697.09

CONSOLIDATED PROFIT AND LOSS ACCOUNT OF JANUARY 31, 1900.

EXPENSES.			
Cost of Goods Sold		$ 16,436,935.19	
General Expenses, Taxes, Depreciations, Losses and Allowances for Losses		2,136,668.38	
Patents and Patent Expenses		353,333.87	$18,926,937.44
Interest on Debentures*			281,666.67
Dividends Paid:			
On Preferred Stock—7% for the year		178,584.00	
On Common Stock—three dividends of 1½% each: paid July 15, '99, Oct. 14, '99, and Jan. 15, 1900		822,420.00	1,001,004.00
Patents and Good Will written off			2,000,000.00
Balance January 31, 1900 (Surplus)			2,353,030.52
			$ 24,562,638.63

EARNINGS.			
Balance January 31, 1899 (Surplus)			$ 156,570.99
Sales		$ 22,379,463.75	
Royalties and Sundry Profits		868,706.70	23,248,170.45
Dividends and Interest received on Stocks and Bonds owned		309,428.23	
Interest and Discount		80,322.06	389,750.29
Profit on sales of Stocks and Bonds		838,857.73	
Less Premiums paid for Debentures purchased and canceled		70,710.83	768,146.90
			$ 24,562,638.63

* On $5,700,000 for ten months and on $5,300,000 for two months.

they were appraised three years ago. The book value of those not readily salable was then fixed, after careful examination of their worth at that time. Those having a market value are still carried under the price of then reported sales. Those more recently acquired are carried at cost.

Accompanying schedules contain lists of the most important of the company's holdings of stocks and bonds. Their total par value is $11,466,309. They are carried at an aggregate book value of $5,754,748.03.

In addition, the company owns various other securities. As their present value is doubtful and the future value speculative, they are not set forth in the schedules. They are carried on the books as follows:

Stocks and bonds of local lighting and street railway companies wholly owned (par value $151,500), $41,852.00. Sundry holdings (par value $418,882), $335,547.01. Miscellaneous securities of many underlying, manufacturing, selling and patent owning corporations, and also of street railway and lighting companies, carried at one dollar for each lot, in all $121, making a total book value of all stocks and bonds, of $6,132,268.04.

The item "Notes and Accounts Receivable," represents the total debts now due the company. They appear at an estimated realizable value—*i. e.* from their face, $7,314,930.12, (which is less than the billed amount of goods shipped during the last ninety days of the year) has been deducted an allowance of $337,119.82 for possible losses (see page 17).

The net amount of sales billed to customers during the year exceeded twenty-two million dollars—those of the last three months aggregating nearly seven million five hundred thousand dollars.

Of some 11,800 regular customers on the accounts receivable ledgers, there were debit balances against 4,600 at the close of the fiscal year.

There are old notes and accounts receivable of one hundred and ninety-two debtors, aggregating $1,272,665.95, which have been written off to profit and loss except the nominal book value of one dollar for each debtor. They stand on the books at a total of $192 and are being liquidated gradually. The total amount realized from this class of notes and accounts by settlements made during the past year was $7,457.46.

In the settlements of old debts, there were realized $185,297.72 over last year's book valuations, less $39,968.82 loss in settling some debts below their appraised value. The net gain above appraised value, was $145,328.90.

The item "Work in Progress," does not include outlays for anything in process of manufacture at the factories, but represents expenditures for labor, material, etc., at cost, on 560 uncompleted installations of finished apparatus in progress at various places, or $1,024,552.60 less partial payments thereon, received under the terms of the contracts as work progressed of $150,424.24, leaving a balance of $874,128.36. None of the estimated profit to be derived from these installations is included in the earnings of the year.

The inventories account represents actual inventories—counted and valued item by item—of raw materials and goods manufactured and in process of manufacture at the factories; of shipments in transit to storerooms of local offices; of manufactured goods in storerooms of local offices; of materials in local repair shops; and also of all goods on consignment.

Raw materials have been valued at the lowest price paid by the company during the last three months of the fiscal year. The market price prevailing on January 31, 1900, was used where it was lower than the lowest price paid by the company during the said three months.

Active-selling finished and partly finished apparatus and supplies were valued at estimated factory cost; inactive or slow selling apparatus and supplies at about 50% of estimated factory cost; and obsolete apparatus and supplies at scrap value.

On the above basis, the inventories of the factories exceeded their book value. Following the practice of previous years the whole of such success has not been taken as a profit, but a portion has been retained as a reserve against possible increased cost of manufacturing, in case of further advance in prices of raw material.

The very large increase over last year's total factory inventories is due to accumulation of work—owing to the unfilled orders in process at January 31, 1900, being $3,000,000 more than those at January 31, 1899—as well as to the increased value of the raw materials included in these inventories.

The company has no notes payable, nor is there under discount any paper bearing the company's endorsement or guaranty. It has not borrowed any money, nor has the company's credit been used during the year either by issuing notes, endorsing customers' paper for discount or lending its name in any way; but by adhering to its established policy of maintaining sales on a basis of cash or short credit to desirable customers, all purchases have been paid for in cash.

During the year the company has purchased and canceled $400,000 of its own 5% gold coupon debentures due June 1, 1922, at an average cost of 117.68 per cent.

"Accounts Payable," includes all unpaid audited indebtedness. At the close of business on January 31, 1900, the unpaid vouchers on hand—none of which was then due under the terms of purchase—amounted to $317,020.03. Between January 31 and February 26, 1900, the date of closing the general books, additional liabilities belonging to the past year were audited, amounting to $686,344.02, giving a total, as per balance sheet, of $1,003,364.05.

The amount of unpaid vouchers carried over in this way monthly—by keeping the books, other than the cash book, open a sufficient time to include each month's obligations in that particular month—has averaged during the year about $860,000.

Southwestern Gas, Electric and Street Railway Association.

THE second annual convention of the Southwestern Gas, Electric and Street Railway Association, held at Waco, Texas, on April 12, 13 and 14, scored another success for this vigorous young body. Though representing practicaly but the State of Texas, the total number of attendants during the several days fell but little short of 100.

At the final session on Friday, April 14, the following officers were elected for the ensuing year: President, J. F. Strickland, of Waxahachie; first vice-president, C. F. Yeager, of Laredo; second vice-president, E. H. Jenkins, of San Antonio; third vice-president, John R. Cullinane, of Denison; secretary, T. H Stuart; directors, J. F. Strickland, C. F. Yeager, E. H. Jenkins, John R. Cullinane, H. F. MacGregor, T. D. Miller and W. S. Rathell. Houston was chosen as the meeting place of next year's convention.

One of the social features of the convention was a meeting of the "Sons of Jove," a social organization formed at last year's meeting. The choice of name is explained as follows: "The finger of authority points unerringly to the ancient Greek and Roman deity, Jupiter, as the father of the phenomena of electricity, and the natural and just conclusion which may be deduced for the purposes of this organization is that the disciples of electricity of the present day are, or should be, the 'Sons of Jove.'" Almost all of the attendants of the convention, not already members, were initiated into the order as satellites of Jove. The tenure of office is limited to one year, and no Jovian is eligible for re-election except Mercury, the secretary. Jupiter, Neptune, Pluto, Vulcan, Mars, Mercury, Apollo, Hercules and Justice are the titles of the various officers, the incumbents of which are Messrs. Aggio, C. W. Hobson, S. A. Hobson, Bonner, W. W. Seley, Newning, C. M. Seley, Brooke and Whipple, respectively.

The meeting was called to order on Thursday morning, April 12, when Captain M. B. Davis, editor of the Dallas *News*, delivered an address welcoming the association to Waco. Captain Davis referred to this as an age of immense achievement "at the head of which stands those two latter-day wizards, those men who command the lightning, Edison and Tesla, who are creating new conditions here and are doing more to civilize this world than all the united pulpits." The address of Captain Davis abounded in clever sayings. Referring to expansion, he said: "Brother gas and electric men, we are immense. We are bounded on the north by the aurora borealis, east and west have not yet been surveyed, and on the tropic of Cancer we warm our feet. We own so many degrees of latitude that in our northern possessions we cannot thaw ice by electricity and in our tropical climates we cannot create ice by the ammonia process."

Captain Davis was followed by Mayor McCullough, who officially welcomed the association to Waco. Mayor McCullough said that while he knew nothing about electricity himself, he had a kinsman, Captain McCullough, of St. Louis, who has been president of the

American Street Railway Association, and who has a son who is an electrician, building an electric railway in Geneva, Switzerland. "So that if I do not know anything about this business myself, I have some relatives who do." President Miller responded in appropriate terms to the cordial welcomes of Captain Davis and Mayor McCullough.

After the consideration of some business matters, President Miller delivered his annual address. Referring to the popular cry for municipal ownership, he spoke of the prevalent idea in the public mind as to the large earnings from public utilities and asked "If our profits are sufficient to enable us to give large dividends to the government for the privilege of doing business, would it not be more logical to allow us to give this amount to our customers in the shape of lower prices?" An adjustment in this nature would, he believes, prove more desirable should the subject be treated in a perfectly impartial way. He spoke of the need of an addition to the criminal code to protect against the theft of gas or electric current, as there is at present practically no means of prosecuting for such thefts in Texas. He also approved of legislation requiring an electric wireman to give bond for proper work, and prompt report for inspection, the same as plumbers and gas-fitters are required to do. Electric light men were counseled to abandon the flat rate evil and get on the meter basis.

Following the reading of the secretary's report Mr. Boyd started a discussion on enclosed arc lamps which was participated in by Messrs. Jenkins, Kelley, Miller, Cullinane and Rathell. Mr. Boyd said he found the expense of operating enclosed arcs considerably in excess of that for the open arc lamp. He had 11 lamps in use and in one year 150 inner globes were broken. Mr. Judge said that he had had two alternating-current enclosed arcs in use for six months and a single globe had not yet been broken Mr. Kelley said that his company is now operating 35 enclosed arcs, having commenced with 10 or 12 a long time ago, and that the breakages have not approached two globes per lamp during the entire period the lamps have been in use. Mr. Cullinane believes that the enclosed lamp is particularly valuable owing to the elasticity which it gives to the lighting service, for enclosed arcs may be installed on an incandescent circuit in the same manner as an incandescent lamp. Its use also enables a station to do away with open arc machines, thus limiting the generators to a single large one, or single kind for the entire electrical service. Mr. Rathell considers that the enclosed lamp is far superior for inside lighting than the open lamp.

The afternoon session was opened by a paper on "Operation of Electric Lighting Plants from a Business Standpoint," by Mr. A. E. Judge, in which he laid stress upon the necessity of the manager of a central station exercising good judgment, securing expert advice and availing himself of accumulated experience. Expert service for each duty, he said, is the rule of success in large industrial organizations. In larger establishments the manager should not be expected to do routine work. It is his business to keep himself posted, to have a clear and comprehensive understanding of the main features of the business, actual and prospective, and to see that these factors are worked out and produce the right business results. Nevertheless he should know and see that the detail and routine work of the business is properly done.

As to measures against accident, stoppage, etc., the best method can even be done by putting down a cement floor, and having the is making the station fire-proof as nearly as is practicable. This walls of brick or stone with a metal roof A comprehensive system of accounts should be kept that the condition of business can at all times, with the least labor, be accurately ascertained and enable fluctuations in its details to become readily known. Reserve boiler, engine and dynamo capacity should be provided and arrangements made to facilitate rapid handling of machinery An effort should be made to popularize the electric light and to extend sales by studying and protecting the interest of customers for a satisfied customer is the best advertisement. The prices should be such that the sales will pay the cost of production plus a reasonable profit, in cost of production being included certain items of fixed charges that remain the same per annum.

Part in the discussion of the paper was taken by President Miller and Messrs. Jenkins, Boyd, Strickland, Rathell and Cullinane. Mr. Jenkins endorsed the statement in Mr. Judge's paper as the manager should intelligently overlook the men over him, and employing those who are trustworthy and capable for the specified duties assigned them, and added that worthy employees should understand that they are in the line of promotion. He dwelt upon the necessity of a comprehensive set of office accounts, so that the condition of the business should at all times be understood. President Miller said hat he had been keeping a weather schedule to meet complaints of bills being higher for one month than for the same month of the previous year. Mr. Boyd said that in his station the accounts were kept under 25 different heads which he did not consider to be excessive. Customers are supplied with a little instruction book and in order to meet complaints as to monthly charges, the meterman draws on a blueprint the position of the hands, the print serving for the 12 months of the year. Mr. oyd considers that by properly subdividing accounts, great economy may be made, as he illustrated by an incident in his own experience.

Mr. W. S. Rathell then read a paper on "Meters and Incandescent Lamps." He spoke of the three different methods employed in fixing the charge for current—by the flat rate and ampere-hour and watt-hour meters. In a test made with the two latter instruments on the same circuit, he found that the indications of the ampere-hour meter was 9 per cent. less those of the watt-hour meter; in another case, the discrepancy was 50 per cent.; in a third case, 35 per cent.; and in a fourth case 20 per cent. difference in favor of the watt-hour meter. Were it possible to retain the voltage constant, the discrepancy would not be so great, but Mr. Rathell considers that with present methods of operating stations, perfect regulation cannot be had all along the line. He believes that if the flat rate system were abolished altogether and the ampere-hour meter relegated to the scrap heap, the door would be open for a considerable reduction of rates and a more adequate return to central stations. As to lamps, it is a duty to patrons that they be provided with an article which will give the greatest possible light with the least expenditure of energy and with a fair average life, but in order to do this the central station man must know something of lamps. Tests of 11 lamps were given, the lamps being selected at random from several sources, and which showed a consumption of energy varying from 56.6 watts to 80 watts per lamp hour. The conclusion is drawn from these tests that different lamps have widely different watt consumption under same conditions, and that there is a wide range of difference in samples of the same make of lamp.

The question was asked, How many dealers in lamps or how many central stations in the territory covered by the Southwestern Gas, Electric & Street Railway Association pursue the system of testing lamps for watt and candle-power? The result of its neglect is that a vast majority of both the dealers and consumers are at the mercy of the manufacturer. As is natural to suppose in the manufacture of incandescent lamps, a large number are lacking as regards proper voltage, candle-power and average life; and it is also natural to suppose that the dumping grounds for such lamps is in a territory in which it is generally known that a set of testing instruments do not exist. Mr. Rathell calls upon the central station manager to provide his plant with a testing-room and complete testing set to determine the voltage, watt and candle-power of all lamps purchased. The central station should refuse to sell current particularly to a flat-rate customer, unless it is used through lamps furnished or approved of by the central station.

In the discussion of Mr. Rathell's paper, Mr. Boyd said that his company has about 200 watt-hour meters installed. In numerous cases when these meters were taken direct from the case and set on the testing-rack, they were found to give all sorts of registrations, necessitating their recalibration before erection. His station sells incandescent lamps, three for $1.00 or a single lamp for 50 cents. Mr. Kelley said that meters should be tested where they are to be used, and added that he had found that meters which will operate nicely on 108 or 106 volts would just creep if tested at the station, owing to the voltage there being 112 volts. Mr. Boyd said that his experience was that watt-hour meters register correctly within certain limits independent of fluctuations in voltage.

A paper followed by Mr. E. D. Kelley on "The Use and Care of Electric Meters." Mr. Kelley advised that a plant should be placed strictly on the meter basis, and gave a number of arguments to show the absurdity of the flat-rate system of charges. Meters should be installed in a secure place where there is no jar and should be protected from dirt and dust. The size of the meter should correspond to the number of lights which it is to serve. Mr. Kelley does not approve of the practice suggested of making heavy lighting months short by reading on the 28th or 29th of the month. Motor service should be on meters, as the use of meters will teach a customer to keep his shaft well lined up and take precautions for reducing waste of power.

The discussion was participated in by Messrs Kuhlman, Cushman, Baker, Jenkins, Judge, Rathell, Cullinane and Strickland. Mr. Kuhlman spoke of the practice in some places of charging for the cost of the meter and allowing a monthly rebate until it is paid for. Mr. Cushman said that cleaning a meter once a year, especially meters with commutators, is not often enough; he also did not agree that meters can be repaired on the spot. Mr. Kelley, in rejoinder, said that more damage was done a meter in carrying it back and forth from the station than it suffers from ordinary use. Mr. Judge said that for the past 12 years his company had been furnishing renewals free of charge, and Mr. Rathell said his company had lately adopted the practice of charging the customer simply what it cost to deliver them lamps. Mr. Cullinane said that he had been selling lamps to customers for 25 cents a piece

At the session of Friday afternoon, after the transaction of some business, Mr. H. F. McGregor read a paper on "The Maintenance and Operation of Street Railways." Mr. McGregor recommends the operation of street railways on the belt system as being more profitable, covering more territory at the same operating expense, with greater protection from accidents than with the double track system, and with less delays and annoyances. In Houston there is an average of a car for every 2500 inhabitants. In Houston, traveling amounts to one fare daily, or less than 20 per cent. of the population. It is not believed that free shows are beneficial, as the class that should be encouraged cannot be given free a 5-cent fare. It is preferable to give people full value for their money in attractions, concerts, etc., at popular prices, say 10 cents for admission and 10 cents for reserved seats. The headway of cars in Houston varies from five hours to 30 minutes on different lines Formerly the outside limit was 20 minutes' service, but it has been found that half-hour service gave the same money on light traffic lines, and that fifteen-minute service increased the travel but slightly. Twenty dollars per day is required for operation and maintenance per car and the profit must be in earning above that.

As to the track, the rails should be 60 pounds or heavier and the base not less than five inches in width. The joints should be cast-welded. The Houston company has a cast-welding machine by which joints are made at the price it would cost to bond, in the former case, however, having a perfect track. It is not certain whether cast-welded joints would give unqualified satisfaction in unpaved streets, though they might if expansion joints were left every quarter of a mile.

It is found that for cypress ties 12 years is about the limit of life. Recently creosoted ties have been used whose life will probably be about 20 years. A number of white cedar poles erected 12 years ago have been replaced, but most of them are good for several years yet. Red cedar poles last longer, but are not as attractive.

Messrs. Strickland, Jenkins, Boyd, Yeager and Miller joined in the discussion on Mr. McGregor's paper. Mr. Jenkins agreed that free entertainments did not pay. He approved the use of cast-welded joints. Mr. McGregor said that cast-welding should not be used with rails lighter than 45 pounds. Mr. Boyd said that some entertaining companies give a percentage of from 50 to 70 per cent. of the gross receipts of electric railways. Mr. McGregor said that in Waco, troupes are hired outright by the electric railway company, which takes all the money and pays the troupes. At San Antonio free concerts are given. At Laredo, a charge is made for the entertainment and something for reserved seats, and a guarantee of $5.00 given for each person in the troupe, transportation also being given. Mr. Yeager said that he made a charge of 50 cents admission and 15 cents for reserved seats on some nights, and on other nights gave free admission. He found that the houses were more crowded on the pay nights, the patrons then being the better class of people. He gives the troupes the rent of the hall, does the advertising and pays expenses, reserving 10 per cent. or 15 per cent. from the receipts to pay the expenses of the attendants and to clean up the hall. In reply to a question, Mr. McGregor said that formerly he paid $3.10 for poles delivered, but now pays $5.00, which includes the price of painting. He considers that creosoting will prolong the life to 20 years.

Mr. E. H. Jenkins, of San Antonio, followed with a paper on "Electrolysis." It consisted largely of a resumé of what has been written on the subject during recent years. In conclusion, he said that from the testimony gathered from various experiments, he feels satisfied that in cities of, say, 100,000 inhabitants and less, if the rails are properly bonded and the gas and water pipes have suitable return connections to the power generators, there is little or no danger from electrolytic damage. In larger cities, however, where underground system of pipes and conduits are more numerous and there is a greater diversity of railway systems, a thorough electrical survey should be made by competent electrical engineers to determine the difference of potential between the rails and the earth and the gas and water pipes near them. When the facts have been ascertained then suitable return conductors can be placed.

The paper by Mr. Jenkins was discussed by Messrs. Strickland, McGregor, Miller, Jenkins and Cushman. Mr. McGregor thought experts exaggerated very much the damage from electrolysis, which can be easily remedied, it being merely a matter of conductivity and providing a proper path. Mr. Miller said that in Dallas a 36-inch water pipe which passed within a block of the power house was considerably damaged. Mr. Jenkins said that San Antonio gas pipes had suffered from electrolysis, but that after connecting up points on the pipe to the track it ceased. He said that street car lines should not be bonded promiscuously with water and gas pipes throughout the city, but the points of bonding determined by a voltmeter exploration. Mr. Miller said that if a pipe is connected where there is a discharge of current from it, the trouble will be relieved. Mr. Jenkins considers that it is a mistake to bond pipes to the rail. The pipes may be temporarily connected to the rail and then the point found where the current comes on to the pipe and the remedy applied there.

Mr. John G. Boyd read a paper on "The Attitude of Municipal Corporations to the Public," in which he considered at some length the feasibility and desirability of municipal ownership, quoting largely from previous writings on the subject. The conclusions from the quotations given are that the result of municipal ownership cannot be otherwise than disastrous. Messrs. Cushman, Jenkins, Miller, McGregor, Yeager, Judge and Strickland, joined in the discussion which followed. The unfavorable results from municipal ownership in the case of the Philadelphia gas works and in that of the Austin dam and plants were commented upon.

At the Saturday morning session a paper was read by Mr. H. L. Monroe on "Poor Incandescent Lighting—Its Chief Cause and Remedy." It dwelt upon the importance of station supply to consumers, an efficient lamp and renewing when it becomes dim. For if the service has all other essentials and the plant is of the most perfect construction and operation, their object is defeated if they fail to give good lighting service. He considers that the system of free renewals is the proper basis of electric lighting business. As long as a customer is charged for his lamps the condition will prevail that if the lamp is not sold cheap enough by the station, customers will buy poor lamps at a cheaper price and he will use a lamp after it becomes dim and inefficient. The actual cost of free renewals will average from ½ to 2-3 cent per kilowatt hour, and if the stations wish to be reimbursed they can increase the meter rates accordingly, or they can offer renewals in place of any reduction in rate. He advises that lamps be removed from the circuit one to four times per year and replaced with new ones The lamps removed which are not reduced in candle-power below a prescribed limit—say 13 candle-power—may be sent out again for use at high voltage points or in locations where reduced candle-power is of slight importance. Or a new lamp may be given in exchange for an old one, for, say, every $3.00 worth of current supplied. The second plan is pronounced an excellent one, as it offers a bonus for use of current and regulates renewals on the basis of the number of hours of lamp service.

The paper of Mr. Monroe was discussed by Messrs. Boyd, Judge, Hobson, Yeager, Strickland, Rathell Miller and Stuart. The consensus of opinion was in favor of free lamp renewals. Mr. Strickland, however, considered that a central station could not afford to give free renewals as it amounted to a donation of 3 per cent. of gross receipts to customers.

In a paper on "Gas versus Electricity for Lighting Purposes," Mr. J. R. Cullinane gave his experience in selling gas and electricity to the same class of people. Flat rates, he said, are an annoyance where the company using them is also selling gas by meter. He advocated the metering at the station of all current sent out and then selling current exclusively through meters to consumers He spoke of a field for electricity, in which it will not hurt the sale of gas—that of supplying small motors and fans. The prices usually paid for power current are more remunerative than those paid for lighting purposes, and nearly every electrical company can operate a power circuit profitably.

ENGINEERING SOCIETY LIBRARY, UNIVERSITY OF MICHIGAN

CURRENT NEWS AND NOTES.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY.—Lectures on "Electricity in Mining" are being given at the Institute by Mr. Timothy W. Sprague. These lectures are included in the curriculum of the course in mining engineering. Students of other departments have the privilege of attending them.

THE MAGNETIC CLUB will hold its spring meeting on the evening of April 28, at the St. Denis hotel, New York. A dinner will be served at 6.30 o'clock. This meeting will occur on the eve of the birthday of Prof. Morse and will be, in a sense, an anniversary of that event. Entertainment will be provided after the dinner.

AUTOMOBILE EXHIBIT IN BERLIN.—An exhibition of electric automobiles was opened in Berlin on April 23, to continue a week. The programme includes careful tests and trial trips under prescribed conditions. It is believed that a great stimulus will thus be given to the use of these vehicles in Germany.

TEST TRIP OF AUTOMOBILES.—About 75 automobiles of various types and sizes started from Hyde Park corner, London, on the morning of April 2, on a 1000-mile trial journey, under the auspices of the Automobile Club. The vehicles will go to Edinburg and return. The trip is not intended to be a race, but as a test of the utility and endurance of the vehicles

STORAGE BATTERY DECISION.—In reporting the decision of Judges Putnam, Aldrich and Brown, in our issue of March 24, in the case of the Hatch Storage Company, a quotation from the opinion in connection with the first claim of the Brush patent read as follows: "A plate or suitable support primarily coated or combined with a *chemically* applied oxide of lead or equivalent lead compound." The word *chemically* should read *mechanically,* that being the language of the opinion. The difference of language in this connection is, of course, a radical one.

RAPID TRANSIT EXTENSIONS.—Mayor Van Wyck of New York, has signed the bill extending the powers of the Rapid Transit Commission to all the boroughs of the city. The bill gives the commission exclusive control over all avenue franchises in the city, and will permit the extension of the underground rapid transit line to South Brooklyn. The Mayor also signed the bill extending certain bonded indebtedness to the counties within the City of New York. The bill will make available $8,000,000 for the extension of the rapid transit system to Brooklyn.

ELECTRICAL CONGRESS.—The following committees were named March 31, to draw up a programme of questions to be submitted to the coming International Electrical Congress at Paris: Scientific Methods and Measuring Apparatus, MM. Hospitalier, Janet and Pellat; Electrochemistry, Electrometallurgy, Storage Batteries, and Electric Furnaces, MM. Bouilhet, Moissan, and Monnier. Telegraphy, Telephony and Miscellaneous Applications, MM. Darcq, De Nerville, Sartiaux and Vivarez. Electro-Physiology, MM. Gariel and De la Touanne. The programme will be submitted April 28 for adoption.

TELEPHONY IN EGYPT.—The Telephone Company of Egypt has its headquarters at Cairo, with branches in Alexandria, Port Said and other towns in Egypt. It has a line running from Cairo to within a few miles of Alexandria, but the government has so far prevented its completion on the ground that it would diminish State telegraph receipts. The company has offered to give the government half of the receipts of the line, and the chief director of the company is now in Egypt trying to get permission to complete the line. Telephone girls are not employed in Egypt, and the "telephone men" have to speak English, French, Italian, Arabic and Greek (modern).

STORAGE BATTERY PATENTS.—Three patents were issued April 17, to Roderick Macrae, dealing with the construction of storage battery electrodes. The electrode is made up of two or more parts each consisting of a slatted structure formed of spaced flat lead strips, united at each end by means of a solder mass, to form an integral structure. In the case of a plate made of three parts, the solid edges of the central one are beaded vertically and fit into corresponding grooves in the solid edges of the end parts, the three parts being held together by soldering at two points. In one of the patents both solid edges of abutting sections are shown grooved to receive a cylindrical lead-covered conducting rod, solder subsequently permanently joining the sections.

BALANCING MULTIPOLAR DYNAMOS.—Owing to differences in the reluctance of the different magnetic circuits of a multipolar machine, a higher e. m. f. may be induced by one magnet pole in an armature than by another, thus producing cross-currents in the armature and interfering with the proper functioning of the machine. To obviate sparking and other trouble from this defect, is the object of a patent granted April 17 to Prof. S. H. Short. A solid copper ring is mounted axially with the armature and connected with the armature winding at equidistant points—at four points in the case of an eight-pole machine. This forms an equalizer arrangement similar to that for equalizing the pressure between several dynamos in parallel. If necessary another ring may be added with connections to the armature midway between those of the first ring.

SYSTEM OF ELECTRICAL TRANSMISSION.—In a patent granted April 17, various details of a system of electrical transmission are described whereby with the use of an auxiliary conductor, currents of differing character may be transmitted over the same line conductors. Briefly, the system consists, where a direct current is to be sent over a single phase line, in bridging the latter at both receiving points by a choking coil. A point of the choking coil winding is then connected in series with the source of direct receiving apparatus is connected between the auxiliary conductor connection point on the sending coil. The patent relates to details of the system and its application to polyphase circuits, and to utilizing direct and alternating current generators and motors as agencies for introducing and withdrawing the second current.

ANNUAIRE GENERAL DE L'AUTOMOBILE.—An indication of the importance of the automobile industry in Europe, and especially in France, is the publication of a directory containing no less than 1194 in the 1899 edition. The 1900 edition will soon be ready and may be obtained from the publishers, F. Thevin & Ch. Houry, 21 Rue du Louvre, Paris. The price is ten francs. The principal contents are as follows: General alphabetical list of all makers of automobiles of every kind in France and other European countries and the United States, arranged under the names of the countries. Classified list of vehicles of various makers. Classified list of makers and special agents for all materials, accesssories separate parts, carriage work, tires, tools, etc., etc., in France and other countries. Classification under countries, departments and towns (France and abroad of manufactures, agents and repairers of automobiles, oil depots, hotels, electrical stations, recharging stations, electricians, clubs, road distances from town to towns, etc. Associations and clubs (list of all members), of all countries; customs, laws, regulations, French patents 1896 to 1899, automobile book publications and journals, exhibitions, races, competitions, etc.

ELECTROPLATING ALUMINUM.—Among the processes at present known for obtaining deposits of other metals on aluminum there are none which form permanent deposits directly on aluminum. For instance, aluminum has first to be prepared in a solution of cyanide of mercury, whereby, of course, an amalgam is formed, and another metal—such, for instance, as copper—is then deposited on the amalgam. This process is suitable for purposes of demonstration, but not for practical working. Metallic deposits should also bear a great degree of heat without losing their thorough adherence; but this is not the case with deposits made by the above mentioned method, as it is well known that amalgams when heated lose the mercury, and the latter when heated must find some way out, whereby the metal on the amalgam is necessarily loosened. Another process is to deposit silver directly on aluminum by means of cyanide of potassium, but such deposits easily peel off. Again, another process consisting in first treating with potash lye is unsatisfactory, as after a certain time the coating becomes loosened. A patent issued April 17 to Eduard Mies of Budesheim, Germany, describes a process which it is claimed, removes the drawbacks above referred to. In this process the metallic aluminum in the form of sheets, wire, or phosphate of sodium and sulphate of magnesium, slightly acidulated with sulphuric acid, then washed with water and subjected to the action of the electric current in the ordinary baths of metallic salts, such as copper, zinc, tin, or the like.

AUTOMOBILE EXHIBITION IN VIENNA.—The Austrian automobile club of Vienna, Austria, will hold an exhibition in that city between May 31 and June 10, this year, of motor cars, vehicles and all appliances and accessories connected with the trade. Foreign goods will be admitted free of duty and returned free of charge to their destination after the exhibition. Valuable prizes will be awarded. They are urging manufacturers in England, Germany, France and the United States to avail themselves of the opportunities offered by the exhibition, not only on account of trade promotion, but to further develop the industry.

ELECTRICAL ENGINEERING STUDENTS ON AN INSPECTION TRIP.—About a dozen students of the electrical engineering course of the Massachusetts Institute of Technology, accompanied by Professors W. L. Puffer and F. A. Laws, and Instructor W. L. Smith, visited the works of the General Electric Company at Schenectady on April 19th. From Schenectady the party traveled to New York City, spending the 20th and 21st looking over the power stations of the Metropolitan Street Railway Company; the New York Gas, Electric Light, Heat and Power Company, formerly the New York Edison Company; and the Kings County Electric Light & Power Company, otherwise known as the Brooklyn Edison Company.

AUTOMOBILE CHARGING STATIONS.—The New Jersey Electric Vehicle Transportation Company has announced that it has arranged to install automobile stations during the coming season at the following points on the Jersey coast: Seabright, West End (Long Branch), Allenhurst, Spring Lake and Atlantic City. At each of these stations Columbia vehicles, both electric and gasolene, of various designs will be for sale, and a specialty will be made of charging and caring for Columbia automobiles owned by private parties. The location of the various stations insures proper accommodations for vehicles and offers a large field for driving. Park wagonettes and omnibuses will be available for special service and for parties wishing to make trips through the surrounding country.

LETTERS TO THE EDITORS.

A. I. E. E. Nominations.

To the Editors of Electrical World and Engineer:

Sirs:—The letters signed by Messrs. Stanley and Perrine in your number for April 21, seem to call for some comment. They each received a copy of the proposed letter on April 5, and after having, presumably, considered it with care, each sent his written consent on the same date; these consents were received and acknowledged on the sixth. Neither offered a word of criticism on the substance or form of the proposed letter.

CARY T. HUTCHINSON.

NEW YORK, N. Y.

The Fessenden Proposals.

To the Editors of Electrical World and Engineer:

SIRS:—I have read with much interest an article by Professor Fessenden on a proposed system of units. When the Congress gathered in Paris to establish a system of practical units—the ohm, ampere, etc.—I considered the action premature. I myself was not a member of that Congress, but talked over the matter with Professor G. Wiedemann, who, while he shared my views and spoke in Paris against the introduction of the units named, was unable to overcome the majority in favor. I simply mention this in order to show to you that from the beginning I was not an uncompromising advocate of the present practical system.

My present view, however, after ripe reflection, is that I would consider any attempt to change the current system of practical units a serious error, because the great machinery of international agreements and national laws must not be treated like a toy. The law-giving bodies of the different countries which bound themselves to the results achieved in Paris and Chicago would rightfully reject any attempt to make a change at present in the international units as uncalled for, and electricians could not receive a more severe blow in the estimation of the public than if they should attempt at present, when the practical units are laws, to come forward with plans for changes. Both the law-makers and the public would characterize such an attempt as frivolous, and I do not see how electricians could well refute such a charge. Attention need be only casually called to the millions of measuring apparatus and the hundreds of thousands of contracts wihch would be affected by a change of units.

Through the laws of the several States not only the conceptions, but the nomenclature of the practical units are fixed, and we cannot agree with Mr. Fessenden when he says that while electricians could sell electrical energy by the ampere and watt, they are not obliged to do so. In Germany it is forbidden by law to sell or measure electrical energy otherwise than by the ampere, watt, etc., and the public sellers of electrical energy are also required by law to use the names of ohm, volt, ampere, watt, conlomb and farad.

With this situation in view, it is my firm conviction that the practical units, such as they have been determined by international agreement and national law, must remain as they are, and that neither their definitions nor their names should be interfered with.

Accordingly, the propositions of Mr. Fessenden, as far as they refer to purely electrical matters, including "capitat," are eliminated at the outset, and there only remains the proposition to introduce "permitat" in place of magnetic permeability. If, in accordance with Fessenden's proposition, we designate permeability by m and "permitat" by μ, the relation between the quantities would be $m = 4\pi\mu$. His reasons are supposed to be based upon the assumption that the introduction of permeability as a fundamental quantity is more nearly in accordance with the Maxwell theory, and its object is supposed to be the elimination of the 4π from the equation.

We will now see whether the object is attained. The formula in which the electro-technician comes most into contact with 4π is the Hopkinson equation for the ampere turns necessary to drive N lines through a magnetic circuit. If we designate the number of ampere turns by Z, the length of each part of the magnetic circuit by l, its cross-section by q, and the permeability by m, and if we furthermore distinguish the several parts of the circuit by 1, 2, 3, etc., we have the Hopkinson formula:

$$Z = \frac{10}{4\pi}\left\{\frac{N_1 l_1}{q_1 m} + \frac{N_2 l_2}{q_2 m_2} + \frac{N_3 l_3}{q_3 m_3} + \dots\right\},$$

or, if the induction $\mathfrak{B}$ is introduced

$$Z = \frac{10}{4\pi}\left\{\frac{B_1 l_1}{m_1} + \frac{B_2 l_2}{m_2} + \dots\right\}.$$

According to Mr. Fessenden's proposition "permitat" is now to be introduced. If this is done, by means of the equation $m = 4\pi\mu$, the formula becomes

$$Z = \frac{10}{16\pi^2}\left(\frac{B_1 l_1}{\mu_1} + \frac{B_2 l_2}{\mu_2}\right);$$

that is, we have no longer 4π, but $16\pi^2$ in the formula. It is suspected that this is not the result desired by Mr. Fessenden. In order to avoid the undesirable result, we must not use $m = 4\pi\mu$, but $\mu = 4\pi m$. Then, indeed, the 4π would disappear in the Hopkinson formula. But there would not be much of a practical gain, because in practice there are more or less air-gaps usually in the magnetic circuit. For this we retain in the denominator the permeability of the air, and as this is already 4π, we must as before make a division with 4π, and the whole difference is that this 4π now has the name of "permitat of the air."

Further, in order to absolutely establish the equation $\mu = 4\pi m$, we must assume that the number of lines of force which come from one magnetic unit pole are $16\pi^2$ and this $16\pi^2$, or at least one of the two $4\pi s$ composing it, would make itself felt in a most disturbing manner in all theoretical calculations in which the Hopkinson unit pole enters. The student, under these circumstances, would probably be compelled to exert himself mentally more upon the 4π than he does to-day.

If Mr. Fessenden's proposition fails so signally in its object, it is proven that something in connection therewith has been overlooked. The fact is that the quantity π does not appear once, but twice in electrical science. It appears first in the determination of the number of lines of force which go from one pole. Here it is introduced by the integration of a spherical surface of radius 1, comes into connection therefore with the number 4 and represents a surface integral in the case of the magnetic pole as well as in the case of an electrical point.

The quantity is again met with if, according to the Biot-Savart law, one expresses the work done by a magnetic point when it encircles a current. Here π is the result of the integration over a circumference. This second π is radically different from the first. Both play their particular parts in theory, and as is to be inferred from what I have

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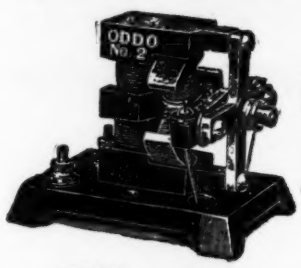

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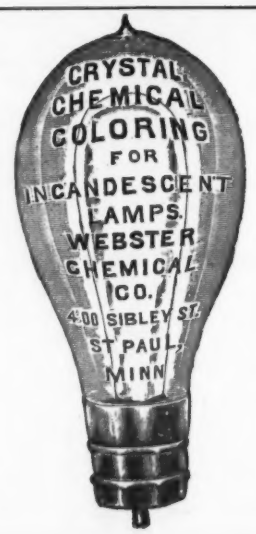

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1	250	"	Commercial, s. o., compound.
1	260	"	National, self-oiler, comp.
1	300	"	Loomis.
1	300	"	Columbia, M.P., self-oiler.
1	300	"	Eickmeyer.
1	340	"	Eddy, self-oiler, compound.
2	350	"	Hawkeye, comp. wound.
1	350	"	Jenney, s. o., comp. new armt.
1	350	"	National, self-oiler, comp.
2	350	"	Edison 20-kw, self-oiler.
1	360	"	Rockford, s. o., compound.
1	400	"	Wood, M.P., s. o.
1	450	"	Rockford, self-oiler.
1	540	"	Edison, 30-kw, oil cup.
7	540	"	Edison, 30-kw, self-oiler.
1	550	"	E. & C. s. s., M.P., s. o.
1	600	"	Eickmeyer.
1	800	"	Rockford, self-oiler, new arm't.
4	800	"	Edison, 45-kw, self-oiler.
1	1350	"	Waddell-Enz, 80-kw, M.P.

ARC DYNAMOS.

1	20-light	2000-cp	Western Electric.
1	25	2000 "	T.-H., ball armature.
1	25	2000 "	T.-H., ring armature.
1	30	2000 "	Western Electric.
1	30	2000 "	Brush, No. 7.
3	35	2000 "	T.-H., L D 2.
1	35	2000 "	T.-H., ring armature.
1	40	2000 "	Wood, No. 7.
3	40	2000 "	Western Electric, s. o.
4	45	1200 "	T.-H., M 12, ball arm't.
1	45	2000 "	T.-H., M 12, ring arm't.
6	45	1200 "	Brush, No. 7.
1	50	2000 "	Excelsior, latest type.
1	50	1200 "	Standard.
4	50	1200 "	T.-H., L D 12.
3	50	2000 "	T.-H., M D 2, new ring armature, self-oilers.
1	50	2000 "	Brush, No. 7½.
2	60	2000 "	Western Electric, s. o.
1	60	2000 "	Westinghouse.
1	60	2000 "	Wood, No. 8.
3	65	2000 "	Brush, No. 8.
2	75	1200 "	Wood No. 8, Ft. Wayne.
1	75	2000 "	Westinghouse, s. o.
3	125	1200 "	Excelsior, latest type.

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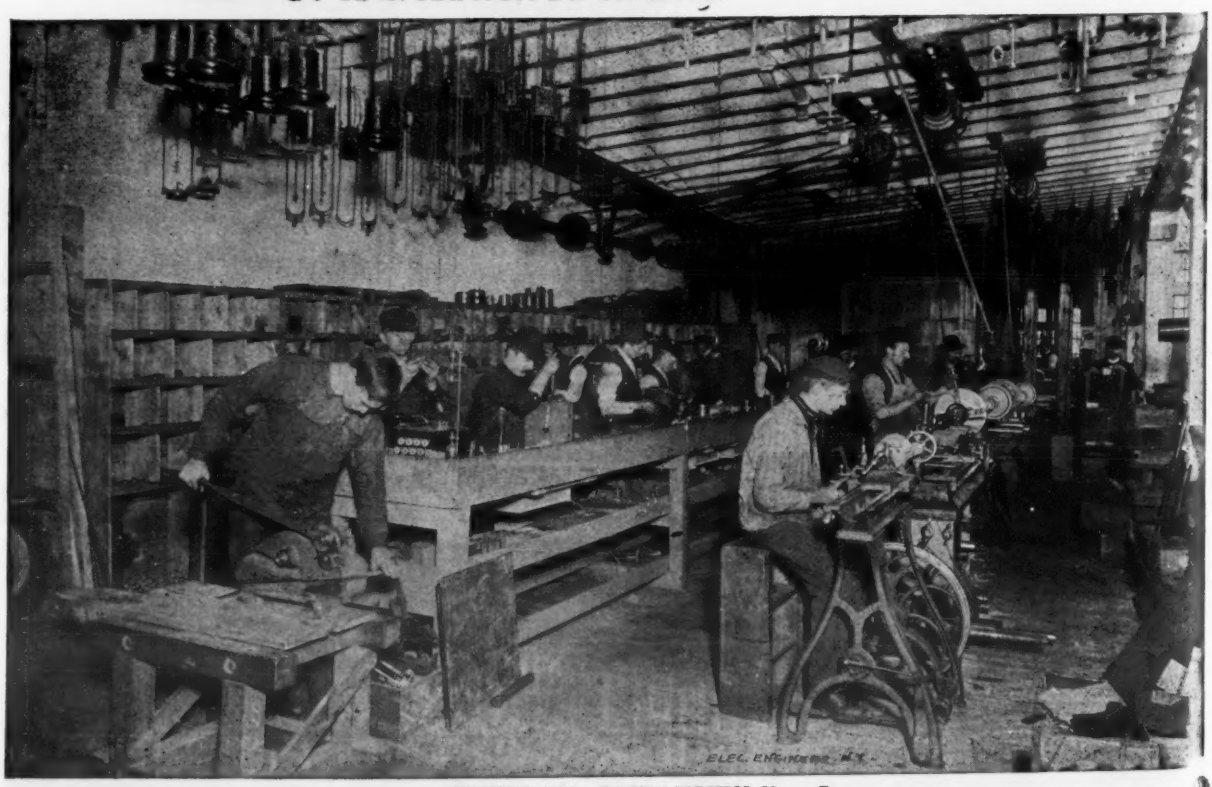

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1 450-kw Westinghouse, single phase, 2200 volts, 7200 alternations, speed 257 r. p. m.
1 525-kw Westinghouse, two-phase, 2200 volts, 72 alternations, speed 257 r. p. m.
2 240-kw Stanley, two-phase, 380 r. p. m., with engines direct connected.
2 300-kw Westinghouse, single phase, toothed armatures.
1 220-235-kw Westinghouse, single phase, 1100 volts, 450 r. p. m., 7200 alternations.
1 250-kw Westinghouse, two phase, 1100 volts, 450 r. p. m., 7200 alternations.
1 150-kw Westinghouse, two-phase, 1100 volts, 600 r. p. m., 7200 alternations.
2 A-120 General Electric, single phase, 1000 volts, 16,000 alternations.
2 90-kw Gen. Elec., single phase, 1000 volts, 16,000 alternations.
2 120 Westinghouse, single phase, 1100 volts, 16,000 alternations.
1 75-kw General Electric, two-phase, 2300 volts, 60 cycles.
2 75 kw monocyclic General Electric, 200 volts, 7200 alternations, with exciters.
1 60-kw General Electric, single phase, 2000 volts, 16,000 alternations.
1 60-kw Westinghouse, two-phase, 2200 volts, 60 cycles.
1 45kw Westinghouse, 2200 volts, 16,000 alternations.
2 A-70 T.-H., 1 000 volts, 16,000 alternations.
1 150-kw Fort Wayne, 2200 or 1100 volts, 16,000 alternations.
2 75-kw Fort Wayne, 2200 or 1100 volts, 16,000 alternations.
2 75-kw Stanley, 2400 volts, two-phase, 16,000 alternations.

DIRECT CURRENT DYNAMOS.

110 VOLTS.

(Direct Connected.)

2 100-kw Westinghouse, 8-pole, 225 r. p. m., direct connected to McIntosh & Seymour compound engines.
2 100-kw units, consisting of one straight line engine and two 50-kw General Electric, 6-pole generators, one on either side of the engine, 250 r. p. m.
1 100-kw Siemens & Halske, direct connected to 15x16 inch straight line engine, 238 r. p. m.
1 75-kw Siemens & Halske, direct connected to 12x14 inch straight line engine, 278 r. p. m.
1 60-kw Westinghouse, 6-pole, direct connected to Atlas engine, 250 r. p. m.

BELTED DYNAMOS.

110 VOLTS.

2 150-kw Edison Bipolar.
4 100-kw " "
4 60-kw " "
4 45-kw " "
4 30-kw " "
4 25-kw "
2 20-kw " "
2 15-kw " "
2 10-kw "
1 500-ampere Onondaga.
1 340-ampere Eddy.
1 25-kw Electro Dynamic.
1 15-kw Westinghouse, horizontal type.
1 30-kw Western Electric, M.P., 500 r. p. m.
1 45-kw Westinghouse, M. P., 850 r. p. m.

DIRECT CURRENT MOTORS AND GENERATORS.

220 VOLTS.

(Direct Connected.)

2 75-kw Westinghouse, M. P., direct connected to Westinghouse engines.
1 75-kw General Electric, direct connected to Ideal engine.
1 80-kw Churchward, direct connected to Russell engine.

(Belt Driven.)

1 100-kw Edison.
1 80-kw Siemens & Halske.
1 45-kw General Electric, M. P., 800 r. p. m.
1 32-hp U. S., 775 r. p. m.
1 20-hp Westinghouse, M. P., 600 r. p. m.

DIRECT CURRENT.

500 VOLTS.

2 60-kw Edisons.
1 50-hp C & C, 700 r. p. m.
1 30-hp, moderate speed, M. P., Westinghouse.
1 25-hp T.-H.
1 25-hp Keystone.
1 25-hp M. P. Eddy.
1 20-hp M. P. Westinghouse.
1 15-hp M. P. Eddy.
1 15-hp M. P. General Electric.
1 10-hp Eddy.
1 3-hp Sprague.

RAILWAY GENERATORS.

2 850-kw General Electric, 80 r. p. m., direct connected to Allis cross compound engines.
2 425-kw General Electric, 100 r. p. m., direct connected to Allis cross compound engines.
1 800-kw Walker, for direct connection.
2 500-kw General Electric M. P., belt driven.
2 500-kw Westinghouse, M. P., belt driven.
2 375-kw Westinghouse M. P., belt driven.
2 200-kw General Electric M. P., belt driven.

ARC DYNAMOS.

2 165-light, multi-circuit Brush, 1200 cp, $2000 each.
2 No. 11, 125-light, multi-circuit, 2000 cp, $1950 each.
2 125-light, single-circuit, 200 cp, Brush, $1700 each.
2 125-light, latest type Fort Wayne, 2000 cp, $1500 each.
2 125-light, brand new Excelsior, 2000 cp, $1500 each.
4 No. 8, 65-light, 2000 cp, Brush, $575 each.

ENGINES.

22 in. x 40 in. x 48 in. Tandem Compound Harris.
26 in. x 60 in. Harris Corliss.
13 in. x 13 in. Armington & Sims.
150-hp Westinghouse Compound.

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1 22x42 Wright Corliss.
800-hp Sterling Water Tube.
2 200-hp National Water Tube.

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1 350-light Thomson-Houston, A18, comp. wound.
1 600 " Bain, 30-kw, self-oiler, new toothed armature.
2 600 " T.-H., A6, 30-kw.
1 600 " T.-H., 30-kw, two-phase.
1 650 " T.-H., A35, s. o., comp. wound.
2 750 " Westinghouse, 16,000 alternations, self-oilers, 37½-kw.
1 750 " National.
1 900 " Westinghouse, s. o., 45-kw. latest type, toothed armature, comp. wound.
1 900 " 60-cycle Westinghouse, 45-kw, s. o., with toothed armature, comp., new wound.
1 1000 " Wood, 50-kw, s. o., toothed armature, latest style, comp. wound.
1 1200 " National, s. o., with toothed armature, new.
1 1200 " Westinghouse, 60-kw, self-oiler, toothed arm't, latest type, comp. wound.
1 2000 " T.-H., 100-kw, self-oiler, new toothed arm't.
2 3000 " Westinghouse, 150-kw, s. o., with toothed arm't.
1 3000 " Westinghouse, 150-kw, s. o., toothed armature.
2 6000 " Westinghouse, 300-kw, latest type, toothed arm't, comp. wound, self-oilers.

110-VOLT MOTORS.

1 1 H.P. Commercial.
2 1 " Belding, M.P.
1 1 " Roth, self-oiler.
1 1 " T.-H., self-oiler.
1 2 " Duplex, self-oiler.
1 3 " Westinghouse.
1 3 " Jenney, self-oiler.
1 3 " Bain, self-oiler.
1 4 " Edison, 3-kw.
1 5 " T.-H., newly rewound, s. o.
1 5 " Wood.
1 6 " Eddy, self-oiler.
1 7½ " Westinghouse.
1 7½ " C & C.
1 12 " Rockford.
1 14 " Howard.
1 18 " National.
1 18 " Commercial, self-oiler.
1 20 " Eickmeyer.
1 20 " Loomis.
1 20 " Columbia, M.P.
1 24 " Eddy, self-oiler.
2 25 " Hawkeye motors.
1 25 " Jenney, self-oiler.
1 25 " Rockford.
1 25 " National, self-oiler.
2 25 " Edison, 20-kw, self-oiler.
1 30 " Rockford.
1 30 " Wood, M.P., self-oiler.
7 35 " Edison, 30-kw.
1 35 " E. & C., M.P., slow speed.
1 40 " Eickmeyer.
1 60 " Rockford, self-oiler.
4 60 " Edison, 45-kw, self-oiler.

220-VOLT MOTORS

3 1 H.P. Sprague, self-oilers.
2 1 " Eddy, self-oilers.
2 1 " E. & C., new, s. o., M.P.
1 1½ " Holtzer-Cabot, self-oiler.
1 2 " Jenney, with extra arm't.
1 2 " Belding, M.P.
1 3 " Crocker-Wheeler, s. o., s. s.
2 3 " Gen. Elec., type I. B., s. o.
1 3 " T.-H., self-oiler.
2 3 " Card, slow speed, self-oiler.
1 5 " Akron, self-oiler.
1 5 " C & C, self-oiler.
1 5 " Gen. Elec., M.P., self-oiler.
1 5 " T.-H., self-oiler.
1 7½ " Ft. Wayne Jenney.
1 7½ " Eddy, self-oiler.
2 7½ " Edison, self-oilers.
1 12 " T.-H., self-oiler.
1 15 " Sprague, self-oiler.
1 15 " Westinghouse, self-oiler.
1 15 " Card, M.P., s. o., new, s. s.
1 16 " Crocker-Wheeler elevator motor, with controller.
1 20 " C & C.
1 60 " Edison, self-oiler, 45-kw.
1 75 " Edison, self-oiler, 60-kw.
1 100 " Wood, M.P., self-oiler.

220-VOLT GENERATORS.

1 10 K.W. T.-H., self-oiler.
1 12 " Westinghouse, s. o., letter type.
1 45 " Edison, self-oiler.
1 60 " Edison, self-oiler, comp.
1 75 " Wood, M.P., s. o., comp.

500-VOLT MOTORS.

1 1 H.P. Jenney, self-oiler.
1 1 " Eddy, self-oiler.
2 1 " Crocker-Wheeler, self-oiler.
1 1 " C & C, self-oiler.
1 1 " Commercial, self-oiler.
1 2 " Lundell, slow speed, s. o.
1 3 " Toledo, self-oiler.
1 3 " Hobart, self-oiler.
1 3 " Jenney, self-oiler.
1 3 " Thomson-Houston.
2 3½ " Rockford, iron clad, s. o.
1 7½ " Wood, self-oiler.
2 18 " C & C, s. o., new arm't.
1 20 " Commercial, self-oiler.
1 20 " Triumph, self-oiler, iron clad.
1 20 " Card, self-oiler.
1 25 " Mather, ring type, new arm't.
1 30 " T.-H., self-oiler.
1 30 " Edison, 25-kw, self-oiler.
1 35 " Jenney, self-oiler.
1 40 " Jenney, self-oiler.
1 40 " Mather, self-oiler.
1 60 " Edison, 45-kw, self-oiler.
1 75 " Sprague, s. o., new arm't.
1 75 " Edison, self-oiler.
1 105 " Crocker-Wheeler, M.P., s. o.

500-VOLT GENERATORS.

1 25 K.W. Commercial, self-oiler.
1 25 " T.-H.
1 25 " Edison, self-oiler.
1 30 " Jenney, self-oiler.
1 35 " Jenney, self-oiler.
1 35 " Mather.
1 45 " Edison, comp., self-oiler.
1 60 " Edison, comp., self-oiler.
1 75 " Westinghouse, M.P., s. o.
1 80 " Crocker-Wheeler, M.P., s. o.
1 100 " Commercial, s. o., comp. M.P., new armature.

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1 25 K.W. 220-volt Eddy, direct connected to Russell engine.
1 60 K.W. Edison, 500-volt.
1 D50 K.W. T.-H. 125-volt.
2 25 K.W. Edison 125-volt.
1 100 K.W. Elwell-Parker 220-volt.
1 75 K.W. 500-volt Westinghouse, direct connected to a 14x24x14 Westinghouse comp. engine.
1 100 K.W. G. E. M. P. 500-volt.
1 50 K.W. C & C 220-volt.
1 D50 K.W. T.-H. 220-volt.
1 60 K.W. Edison 125-volt.
1 25 K.W. Eddy 500-volt.
2 10 K.W. U. S. 110-volt.

ENGINES.

2 Straightline, 10x16.
1 N. Y. Safety, 15x12.
2 N. Y. Safety, 11x12.
1 N. Y. Safety, 8x9.
1 1000 H.P. Fraser-Chal.
1 Ball & Wood, 12x12.
1 Erie Ball, 10x12.
1 450 H.P. Wright engine, cross compound.
1 18x36 Cooper Corliss.
1 Armington & Sims, 13x13.
1 100 H.P. West.
1 15 3-16x16 Ball.
2 12x12 Ball.
1 13 x 20 x 15 comp. Dick & Church.
1 12x12 A. & S.

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1 3 H.P. single-phase, 104-volt Fort Wayne.
1 ½ H.P. single-phase Stanley.
2 4 H.P. Perrett, 220-volt.
1 18 H.P. 500-volt Bates.
2 30 H.P. 125-volt, Edison Bipolar.
1 3 H.P. Crocker-Wheeler 110-volt.
1 100 H.P. 220-volt.
1 5 H.P. single-phase.
1 12 H.P. D10 T.-H., 500-volt.
1 30 H.P. Eddy 500-volt.
1 52 H.P. C & C 500-volt.
1 6 H.P. 220-volt Storey.

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2 60 K.W. G. E. single-phase.
2 60 K.W. Slattery, single-phase.
2 70 K.W. G. E., single-phase.
1 45 K.W. Westinghouse, single-phase.
1 30 K.W. Westinghouse, single-phase.
1 37½ K.W. Ft. Wayne, S.-P.
6 A35 T.-H.
1 60 K.W. Stanley, 2-phase.
1 A120 K.W. T.-H., G. E., 1040-volt.
1 A18 K.W., T.-H., 1040-volt.
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1 75 K.W. Westinghouse, single-phase.

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1—30 H.P. Eddy Bipolar motor, 500 volts.
1—30 H.P. Eddy Bipolar motor, 220 volts.
2—10 K.W. U. S., 110-volt dynamos.
1—32 Light Edison Arc Dynamo.
1—100 Light Edison, shunt wound, 125 volt Dynamo.
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1-500 " Loomis.
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1- 75 " Ft. Wayne.
2-100 " Gen'l Elec.

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1— 30-kw Edison bipolar, 125 volts, comp.
1— 15-kw Edison bipolar, 125 volts, comp.
2—150-kw, 500 volts, Edison bipolar, comp.
2—120-kw, 500 volts, 550 r.p.m., 4 pole, Mather.
1—37½-kw, 1100 volts, Slattery, 600 alternations.
1— 60-kw Westinghouse, 2 phase, 60 cycle.

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already stated, they cannot at the same time be shut out of the theory. At all events, I cannot see that the 4π creates as much mental effor as Mr. Fessenden says it does. The pages in Maxwell on this subject can be readily mastered in one hour by anybody of mathematical attainments, and even while one may change the definitions at will, the student must nevertheless work through these pages in order to become thoroughly acquainted with the theory of electricity. In my opinion, therefore, there would be no lightening of his task by attempting to dislodge the old units.

Perhaps, however, the burden which, according to Mr. Fessenden's idea, is imposed upon the student by the present status of the theory, is artificially produced, and is due to the use by teachers and writers of inaccurate or wrong definitions. Mr. Fessenden, for instance, says "the Henry is 10^9 lines and not 10^9 units of magnetic quantity." In reality the Henry, according to the Chicago definition, measures neither a magnetic line nor a magnetic quantity, but is a unit (in the electromagnetic system) of the co-efficient L in the equation

$$Ri + L\frac{di}{dt} = E$$

for the relation between current i and electromotive force E is a circle containing resistance R and self-induction L. The Henry in its nature, therefore, is a length of 10^9 cm.

Besides this, Mr. Fessenden confuses in the well-known Maxwell equation $B = H + 4\pi T$ the quantities H and T and makes other like errors. These classes of errors increase the difficulty of understanding the subject.

In conclusion, I wish to call attention to a simple method of removing the little difficulties attending the division by 4π. The electrician is never in a position to have every piece of tin or iron with which he works inspected as to its permeability. He, in fact, depends upon the permeability of the material which he receives from trustworthy dealers. A dozen measurements are taken in connection with this permeability and then the $\mathfrak{B}$ used in practice must be interpolated. We must also make graphic tables of these permeabilities, and there is but little work necessary, if instead of a graphical demonstration of these permeabilities, m, the curve at once gives the value $\frac{10}{4\pi m}$, or, better still, the logarithm of this quantity. Then it is clear that further calculations are very simple.

EMIL BUDDE.

BERLIN, GERMANY.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

By CARL HERING.

DYNAMOS, MOTORS AND TRANSFORMERS.

Alternators Connected in Parallel.—AICHELE.—A communication referring to the paper of Goerges (Digest April 7) and describing an apparatus for measuring the maximum value of the lead or lag of any material point of the rotating part, before or behind that position in which it would be at the same instant if the speed in each revolution were uniform. On an axle, a friction disc is mounted, which is pressed against the flywheel of an engine. On this axle a flywheel is mounted loosely so that it rotates with a uniform average speed, while the axle follows all variations of the speed of the engine; the relative motions of the axle to its flywheel, are registered. The way in which the flywheel is loosely mounted on the axle is described and the apparatus is illustrated. A fuller description of the same and of its application for measurements with different types of engines and gas motors is promised.—*Elek. Zeit.*, Mar. 29.

REFERENCES.

Multipolar Construction.—ADAMS.—A comparison of the general features of bipolar and multipolar electrical machines.—*West Elec.*, Apr. 14.

LIGHTS AND LIGHTING.

Combinations of Arc Lamps.—GIRAULT.—The first part of an article in which he discusses systematically the combinations of lamps which are possible to use with constant pressure and constant current systems; the style of lamps which he discusses are first those which regulate to keep the current constant, therefore termed constant current lamps (not meaning thereby lamps on a constant current circuit), those which regulate for constant pressure, and those which regulate for constant apparent resistance, otherwise termed differential lamps. For use on constant pressure distribution systems, he discusses nine special cases, showing that several constant current lamps as above defined cannot be connected in series, but that only one can be so used; on the other hand, it is possible to connect in series any number of constant pressure lamps and constant apparent resistance lamps. If a number of constant pressure lamps are connected in series, good running requires the use of resistances. A single constant current lamp may be connected in series with any number of constant pressure lamps, even without regulating resistances; also with any number of constant apparent resistance lamps; also with any number of constant pressure lamps and constant apparent resistance lamps.—*L'Ind. Elec.*, Mar. 25.

REFERENCES.

Gas and Electric Light.—DE SEGUNDO.—The beginning of an article on the relative merits of gas and electric lighting. The present part does not contain anything new.—Lond. *Elec. Rev.*, Apr. 6.

Pan-American Exposition.—An illustrated article on the electric illumination of the exposition at Buffalo in 1901.—*Sc. Amer. Sup.*, April 21.

Arc Light for Photo-Micrography.—A. C. SCOTT.—An illustrated description of an automatic focussing arc lamp, placed in a nearly horizontal position, so that the major part of the light is projected vertically upward, passing through a condensing lens and the object to be photographed, and thence to the sensitive plate. The lamp is claimed to give excellent results when used on a 110-volt circuit with 20 amp.—*Elec. Rev.*, April 4.

POWER.

REFERENCES.

Automatic Reversing and Starting Resistances for Elevator Motors.—An illustrated description of a device of the General Electric Company, of Berlin, in which the starting resistances are switched out gradually with the aid of a train of wheels provided with vanes.—*Elek. Zeit.*, Mar. 29.

Automobile Brake.—A reprint of the illustrated English article noticed in the Digest Apr. 14.—*El'ty*, Apr. 14.

Electric Driving in Shops.—An article discussing briefly the following four systems: Individual motors; the group system; comparatively long lines of shafting, each driven by its motor; a combination of the individual and group systems.—*Am., Eng. & Rr. Jour.*, February; *Jour. of Elec.*, March.

Improved Efficiency of Engines.—An illustrated article on the device of Behrend and Zimmermann, described in the Digest Jan. 6.—*Can. Elec. News*, April.

Direct Connected Waterwheels and Generators.—PERKINS.—An illustrated article, giving brief illustrated descriptions of the use of generators direct connected with turbines at Columbus, Ohio, in the power transmission plants at Mt. Whitney, Cal., and at Helena, Mont., and in the plant of the Boston & Montana Consolidated Copper & Silver Mining Company.—*West. Elec.*, Apr. 14.

Southern California.—A map of parts of the counties of Los Angeles, Orange, Riverside and San Bernardino in Southern California, showing electrical transmission lines; with brief notes on the 33,000 volts, 83-mile system of the Southern California Power Company, the plant of the San Antonio Light & Power Company, which was the initial plant to use 10,000 volts in daily commercial service, and those of the San Gabriel, Redlands and San Bernardino Electric companies.—*Jour. of Elec.*, March.

Oelwein Shops.—An illustrated description of the electric power distribution system of the railway repair and machine shops at Oelwein, Iowa; 220-volt direct current is used.—*Elec. Rev.*, Apr. 4.

TRACTION.

Combined Trolley and Accumulator Traction.—ZACHARIAS.—An

article referring to the breakdown of this system in Berlin during the snowstorms of last winter (Digest Jan. 27, Feb. 17). He does not agree with Albrecht who prefers the grid plate, as used in Dresden, to the Planté plate used in Berlin (Digest Feb. 17). The system with positive Planté and negative pasted plates is the only one possible to use in Berlin, as the stops at the terminals are very short, so that the charging must be done from the trolley while running. Quick charging with high current is not possible with grid plates. A Planté plate of 30 amp. hours is charged in 15 minutes to 15 amp. hours—that is, to half its capacity, while a grid plate does not receive in the same time more than a tenth of its capacity. Besides, quick charging of grid plates causes the active mass to break up and fall out. Grid electrodes may be used to advantage in a pure accumulator system, as in Charlottenburg, as there the charging and discharging currents are small and the battery of 420 amp. hours, if discharged with 30 amp., may weigh 14,300 to 15,400 pounds, while in a mixed system, as in Berlin and Hanover, the battery weight should not be over 4000 to 5500 pounds.—*Centralbl. fuer Accum. und El. kunde,* Mar. 15.

Automobiles.—PUMPELLY.—An article on the standardization of automobile batteries. He proposes to establish sizes and weights for each class of electric vehicle, and to number such sizes: For instance, a No. 1 vehicle might be a carriage in the 1200 lbs. class, calling for 42 cells of a certain size and work; No. 2, weighing 2000 lbs., and calling for a battery of such and such size; the size is important to be standardized, because the floor space in the carriage is generally of arbitrary or fixed dimensions.—*West. Elec.,* Apr. 7.

Tramways in France.—Full statistical tables showing the condition of electric tramways in operation and in construction in France on January 1, 1900. A small table gives a summary which shows rapid progress; there are now 467 miles of track against 302 on January 1, 1899, the total power is 28,308-kw against 18,718, the total number of motor cars 1295 against 759, the number of trolley lines 56 against 42, conduit lines 3 against 2, third-rail line 1 against 1, accumulator lines 6 against 6, combined trolley and accumulator lines 4 against 4, combined trolley and conduit lines 2 against 1, total number of lines 72 against 56.—*L'Ind. Elec.,* Mar. 25.

Accumulator Traction.—An editorial note saying that the abandonment of the storage battery system on the Chicago & Englewood Electric Ry. probably marks the end of the use in this country of storage batteries as a means of street-car propulsion. The fatal obstacle to its success is the fact that the electric trolley system can meet every requirement and do the work at a considerably lower cost. There is no reason to believe that compressed air stands a better chance of success, save possibly for a limited application under peculiar local conditions, as on the cross-town lines on Manhattan Island.—*Eng. News.,* Apr. 19.

Electric Launches.—A note stating that electric launches are going to enter into rivalry with the steamboats this summer in Venice. The launch to be used carries fifty passengers and is fitted with 108 accumulators. The ordinary speed is seven miles per hour. —Lond. *Globe; Sc. Amer. Sup.,* Apr. 21.

REFERENCES.

Track Construction.—An illustrated description of the track construction on the Central London underground electric railway.—*Eng. News,* Apr. 12.

Automobile.—An illustrated description of the Vedovelli and Priestley cab, taken from a French article noticed in the Digest Aug. 12.—*Sc. Amer. Sup.,* Apr. 14.

Chicago.—An illustrated description of the powerhouse of the South Side Elevated Railroad Company, of Chicago.—*West. Elec.,* Apr. 14.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Electrical Equipment of British Warships.—GROVE.—The beginning of an illustrated abstract of a very long paper, read before the Brit. Inst. of Elec. Eng. In the first part the general equipment is dealt with, the size of dynamos varies by steps of 100 amp. from a machine giving 100 amp. in the case of small vessels to one of 600 amp. now used in all modern battleships and large cruisers. The standard voltage is 80 in all cases, a compromise between the pressure required for searchlights and that giving the best efficiency in the ordinary light circuits; but this low voltage is becoming increasingly inconvenient. The standard speed for all sizes of machines beyond 200 amp. is 300 to 320 revolutions per minute; in the smallest sets the speed sometimes attain 500 revolutions; and, with forced lubrication, this speed is now being used for the larger sizes. The Admiralty specifications insist upon a low steam consumption in the engines working the dynamos, and they require that after a six hours' run at full load the temperature of the machine shall not exceed 80° F. above that of the surrounding atmosphere. Ironclad machines are often used owing to disturbances of the compass readings, which have been observed to be due to the direct influence of the dynamos; but the ironclad type is now being superseded by an open four or six-pole machine which, on the whole, provides the best combination of good ventilation, minimum external leakage, and accessibility of parts. The standard British Admiralty pattern switchboard consists of a slate or slates carrying horizontally upon them a series of omnibus bars connected severally with the positive and negative terminals of the dynamos, and bridging over these a series of vertical slotted bars leading through fuses to the circuits, and carrying sliding contact plugs, which can be pressed down so as to make contact on the top and sides of the omnibus bars, being locked in the "on" position by a spring handle, and maintained in the "off" position by the action of an internal spiral spring, which also gives a quick break; the method of making contact leaves much to be desired, and the switch parts consist of a number of components, which give complexity and add to the cost of maintenance. In other navies than the British and in many ocean liners, parallel working is now in successful operation, which is said to be a distinct advantage upon the British navy practive. The switchboard of the United States battleships Kearsarge and Kentucky is described.—Lond. *Elec. Rev., Elec. Eng.,* Apr. 6.

Two and Three-Phase Systems.—TOMLINSON.—A brief paper, read before the Master Elec. Contractors' Assn., in Dublin, on the extension scheme of the alternating current electric lighting system of that city. He discusses the relative merits of two-phase and three-phase currents. He thinks that if two-phase currents will serve, then three-phase currents are a needless complication; whether they will serve or not, depends upon the action of the starting and stopping of motors upon the lighting circuits. The saving in copper to be made by the adoption of the three-phase system is said to be offset in practice by the increased complication in switches fuses, cables, transformers, and their increased cost. He calls attention to a point with respect to two-phase, as opposed to three-phase currents, which is the facility with which they lend themselves to the conversion of an existing single phase substation system, supplying light only, to a system supplying power, the distributing mains of which are not to be disturbed, if the mains be grouped so that opposite phases are supplied to opposite sides of the streets, power can be supplied at the cost of bringing a main across the street.—Lond. *Elec. Rev.,* Apr. 6.

Systems of Charging.—A full account of a very long discussion which took place in the Municipal Council of Elberfeld (Germany) concerning the question of which system of charging would be the most profitable for the new municipal electric plant (Digest Sep. 16). The majority of the Board of Managers of the plant wanted to charge 15 cents per kw hour for lighting and 5 cents for motors, and to allow a discount on these prices according to the total kw hours consumed per year. The minority wanted to charge at the rate of 15 cents per kw hour for the first 400 hours of simultaneously lighted lamps (corresponding to $60 per kw year) and 7½ cents per kw hour for all hours in excess of that; in dwelling houses 25% of all installed lamps should be assumed to be burning at the same time; in restaurants and hotels, 50%; in stores and offices, 75%. The principal speaker in favor of the latter system was Mr. Lindley (Frankfort o. M.), consulting electrical engineer for the new plant, who suggested this system, which is approximately the same as the one in use in Frankfort, but the former proposition was carried. Induction motors of the short-circuited armature type up to 7-kw are allowed to be connected to the alternating current mains; the motors to be connected are first to be examined and approved by the station authorities, but the permit to use them may be withdrawn if a motor when starting or while running should prove to act disadvantageously upon the network.—*Taegl. Anz. fuer Berg u. Mark.,* Feb. 4.

REFERENCES.

Methods of Charging.—LACKIE.—A longer abstract, illustrated by a diagram, of the paper noticed in the Digest April 21. Also some editorial notes on the paper.—Lond. *Elec.,* Apr. 6.

Rates of Charging.—A reprint of the official regulations, giving those of the Charlottenburg electric plant.—*Elek. Zeit.,* Mar. 29.

Lighting Companies.—An analysis of the financial conditions and of the business of six London and two provincial British lighting companies. No general conclusions are drawn.—Lond. *Elec. Rev.*, Apr. 6.

Doncaster.—The first part of a description of this recently opened British lighting plant. The continuous current three-wire system is used.—Lond. *Elec. Eng.*, Apr. 6.

St. Petersburg.—The first part of an illustrated description of an alternating current lighting station in St. Petersburg, Russia.—Lond. *Elec. Rev.*, Apr. 6.

WIRES, WIRING AND CONDUITS.

Phono-Electric Wire.—MAGUIRE.—An article stating that while up to the present time hard drawn copper and composite wires of copper and steel have been the main reliance in practice, phono-electric wire has been recently brought forward as an improvement by the concern which first made and gave hard drawn copper its name. A table gives the breaking weight, the tensile strength, and the resistance per 1,000 feet, of different sizes of this wire, and indicates that it is more than twice as strong as annealed copper and nearly 50 per cent. stronger than hard drawn copper; it is also claimed that the good properties are permanent. A second table shows that removing 1-64th inch of the surface of hard drawn copper wire noticeably lowers the tensile strength, while 1-32d inch below the surface there is practically nothing left but soft copper. Another table gives a comparison between the elastic limits of hard drawn copper and the phono-electric wire. Trolley wire has to stand the small arcs, set up between trolley wheel and wire, and burning and roughening the surfaces; phono-electric wire is claimed to be free from this serious difficulty, as it does not maintain an arc readily, and it does not anneal.—Lond. *Elec. Rev.*, Apr. 6.

Snow on Telephone Wires.—A note on some observations made last winter by Pierard, near Malines. A bronze wire 2 mm. in diameter, collected snow the weight of which was 1.78 that of the wire. A smaller wire, 1.4 mm. in diameter, collected snow 4.38 times its own weight. The result of the snow collecting on the wires running from the central office in Brussels imposed an extra weight of over 30 tons on the supports over this office. In calculating the deflections produced by the heavy coats of snow, he found that in many cases the long spans were safer than short ones, because the long spans sagged sufficiently to enable the central portions to find additional supports on house ridges, etc.—Lond. *Elec. Eng.*, Apr. 6.

A paper on what seems to have been the same experiments, states that it was hoar frost and not snow. He arrives at the apparently paradoxical statement that for short spans the wire would be apt to be broken, while for long ones this is not the case owing to the fact that the sag will give it new resting points.—*Bull. de la Soc. Belge d'Elec.*, January; abstracted in *L'Ind. Elec.*, Mar. 25.

Electric Wiring.—A brief illustrated article on a system of wiring used by Pindar. The arrangement consists in entirely isolating the positive from the negative conductors behind the fuse and switchboards. In order to do this he arranges two broad cableways up the side of the wall immediately above the fuseboard, and places the whole of the positive conductors in one of these ways, and the negative conductors in the other.—Lond., *Elec. Eng.*, Apr. 6.

REFERENCES.

Voltage Drop in Alternating Current Lines.—FLEISCHMANN.—An article in which he develops analytically three exact formulas for the voltage drop in an alternating current line.—*Elek. Zeit.*, Mar. 29.

Inductance.—Some formulas for the coefficient of self-induction and mutual induction of transmission lines.—*Jour. of Elec.*, March.

ELECTRO-PHYSICS AND MAGNETISM.

Three-Phase Currents.—BRAGSTADT.—An account, illustrated by diagrams, of a theoretical and experimental investigation of the wave form of a three-phase current. If it is transmitted by three wires, the algebraical sum of the currents in the three phases at each moment must be zero; from this he deduces the fact that in a three-phase current all higher harmonics are possible except those of which the frequency is 3, 6, 9, . . . times that of the fundamental wave. If the positive and negative parts of the wave are equal, the higher harmonics with frequencies of 2, 4, 6, 8, . . times that of the fundamental wave must be zero, so that only those harmonics are possible, the frequencies of which are 5, 7, 11, 13, 17, 19, . . . times that of the fundamental wave. At any point and at any moment the sum of the instantaneous e. m. fs. must also be zero, as, for instance, at the terminals of the three-phase generator. The e. m. fs. induced in the phases of a three-phase generator with star connection may have any number of higher harmonics. Those which have frequencies 3, 6, 9, . . . times that of the fundamental wave give a resultant equal to zero. He calls them internal pressures and develops a simple formula, which enables the effective e. m. f. between two phases to be calculated from the effective e. m. f. of each phase and the internal pressures; by neglecting the internal pressures, he obtains therefrom the usual formula stating that the e. m. f. between two phases is $\sqrt{3}$ times that of each phase, which formula, however, is shown to give too great results in many cases on account of the neglecting of the internal pressures. He describes some experiments in which the existence of internal pressures were proved and their frequencies were measured. He introduces the term internal power factor of a three-phase generator and represents it graphically.—*Elek. Zeit.*, Mar. 29.

Capacity for Polyphase Charges.—GUYE.—A mathematical article in which he shows that the capacity of a conductor, defined as the charge which raises it to unit potential when surrounded by conductors whose potential is zero, while in general a constant quality, is not necessarily so, as for instance in the case of conductors subjected to polyphase voltages; but even here the capacity may be constant, provided the conductors under the influence of the polyphase current are symmetrically disposed.—*Comptes Rendus*, Mar. 12; *L'Ind. Elec.*, Mar. 25; abstracted in Lond. *Elec.*, Apr. 6.

Coherer.—CAMPANILE and DI CIOMINO.—An illustrated account of experiments showing that "the behavior of a mercury globule coherer subject to the action of extra current potentials and electric waves is analogous to that of the particles in an ordinary filings coherer under the same actions," and that "a coherer becomes conducting along certain lines and not in the entirety of its mass."—*L'Elettricista;* translated in abstract with illustrations in *Elec. Rev.*, Apr. 4.

Resistance and Residual Charge of Liquid Dielectrics.—NACCARI.—An account of experiments on xylol, tolnol, benzol, and various petroleums, showing that the rise of temperature produces an increase of conductivity of the same order as that in electrolytes and greater in proportion to the original resistance. In dielectrics of high resistivity the residual charge is also high; it diminishes with increasing temperature, but not in proportion to the diminution in the resistance. Residual charges are possibly due to some lack of homogeneity in even a simple liquid.—*Accad. Sci. Torino, Atti*, 34, 15a, p. 820; briefly abstracted in *Science Abstracts*, March.

Atmospheric Electricity.—A note calling attention to the theory developed by Elster and Geitel, and independently by J. J. Thomson and Wilson. The sun's light, especially the ultra violet rays, ionizes the atmosphere producing equal numbers of positively and negatively charged ions. These ions are ordinarily present in equal numbers in dry air, and their charges do not therefore develop any perceptible electric potential. When the air is cooled below its dew point, however, the negative ions mainly serve as nuclei upon which the moisture is condensed in drops, which in falling remove the negative ions, so that an excess of positive ions remains, which gives rise to very great electric potentials and produces the electric effects accompanying rain. The reasonableness of this theory is that every physical action which enters into it, has been followed in the laboratory—the ionization of air by ultra violet light, the condensation of moisture on the negative ions, etc.—*Science*, Apr. 13.

Roentgen Rays.—ROLLINS.—An illustrated continuation of his long serial, giving notes on the occlusion and chemical combination of hydrogen in the glass of the tubes; also on heating Roentgen tubes having high resistance. The resistance of a tube is not an indication of the degree of the vacuum. Tube makers should not take a tube from the pump unless it glows with a brilliant, white light, after the current has been cut off; this phosphorescence is always present in a fine tube. Then follow notes on the "radiant area plume," on the fan of the Varley stream, and on "non-radiable cases for X-light tubes."—*Elec. Rev.*, Apr. 11.

Electrification by the Evaporation of a Liquid.—HENDERSON.—An illustrated Royal Society paper, describing experiments made to determine whether the evaporation of an unelectrified liquid produces any electrification or not. The liquid used was fused sodium and the arrangement of the apparatus is described and illustrated. His experiments lead to the conclusion that evaporation of fused sodium does not give electrification, such as could be detected by

the method used, unless oxidation is going on.—Lond. *Elec.*, Apr. 6.

Change of Volume by Magnetization.—Nagaoka and Honda.—An account of an experimental investigation of the change of volume and of length in iron, steel and nickel ovoids, due especially to strong magnetization. Wolfram steel was also tested with a result which showed a remarkable difference from ordinary steel as regards the change of dimensions produced by magnetization. The change of volume is very small in iron and nickel in weak fields, but with strong magnetizing force the effect becomes generally pronounced. The results are given in diagrams.—*Phil. Mag.*, April

Contact and Chemical Theories.—Lodge.—The first part of a reprint in full of his presidential address to the British Physical Society on the controversy concerning Volta's contact force, an abstract of which was noticed in the Digest, Mar. 17.—*Phil. Mag.*, April.

Electrolytic Conduction in Gases.—J. J. Thomson.—A brief reply to the paper of Morris-Airey, noticed in the Digest, Apr. 7.—*Phil. Mag.*, April.

Nature of Stratified Discharges.—Pellat.—A longer abstract of the French Academy note, noticed in the Digest March 31.—*Sc. Amer. Sup.*, Apr. 21.

Radiography.—A brief illustrated description of Buguet and Chaubaud's radiographic bulb with a water-cooled anti-cathode.—*Sc. Amer. Sup.*, Apr. 21.

Zeeman Effect.—Blythewood and Marchant.—An illustrated article on the Echelon spectroscope, with an application for investigating the Zeeman effect in the chief lines of the mercury spectrum. —*Phil. Mag.*, April.

Magnets.—Chree.—A paper discussing the results obtained in the determination of the values of the constants, temperature coefficient, induction coefficient, moment of inertia, and distribution correction, of over a hundred collimator magnets of the Kew pattern at Kew Observatory.—*Roy. Soc. Proc.*, Nov. 30; abstracted in *Science Abstracts*, March.

Electro Chemistry and Batteries.

Dry Accumulators.—Liebenow.—An article in which he shows that so-called dry accumulators have disadvantages, inherent in their construction and which therefore cannot be overcome under any conditions. For a long life, accessibility and easy revision of the plates are of the greatest importance, in order to find out when and where short circuits are forming. Short circuit can easily occur in dry accumulators. When, on account of too long a discharge, the positive plate gets a tendency to shrink or bend, the active material does not prevent the ultimate resulting contact of the positive and negative plates; the process of shrinking occurs slowly, but with great force. Even more injurious are cracks in the active material and all the small interspaces, if a relatively large size of grains of powder is used, as these interspaces become gradually filled with sludge of very fine peroxide from the positive plates, so that eventually a short circuit is formed. Gelatines have to a smaller degree the property of forming cracks: to prevent them, Schoop tried to mix gelatines with fibrous asbestos, but the desired result was not obtained. Worse than gelatine are coarse powders and filaments; if, however, finer materials are used, another difficulty arises, namely, a considerable decrease of capacity. He explains this by the theory of Dolezalek, according to which fresh acid is brought into the pores of the accumulator plate not only by diffusion, but also to a great degree by local concentration currents set up by the differences of concentration; when this transport of fresh acid into the pores stops, the discharge is at an end. In porous con-conducting materials filled with sulphuric acid, such concentration currents cannot exist, as there is no metallic return conductor; in this case only the diffusion acts, but it acts very slowly. This is an inherent disadvantage of any dry accumulator.—*Centralblatt fuer Accum. und El. kunde*, Feb. 15.

Softened Positive Accumulator Plates.—Peters.—An account of some experiments with softened lead peroxide plates. The concentration of active oxygen and peroxide of lead is nearly equal on the surface and in the interior of the plate in normal hard plates, while in softened plates it is considerably greater in the interior than on the surface. On this observation he bases an explanation of the softening of the plates.—*Centralblatt fuer Acc. und El. kunde*, Apr. 1.

Accumulators for Automobiles.—Vollmer.—A comparison of the relative merits of the Planté and the Faure accumulators for automobiles. The Planté type permits high discharge currents to be used without a considerable loss of economy; the time of charging is small, fifteen minutes being sufficient for a battery of 80 amp. hours; these disadvantages, also that of a greater life, are somewhat counterbalanced by the heavy weight, the greater volume and the smaller capacity. The Faure type has a smaller weight, a smaller volume and a greater capacity, but if it is discharged at a current above the normal discharge current, the capacity and life are diminished; the time of charging is long, four to five hours being necessary for a battery of 80 amp. hours. A battery of 44 cells giving 80 amp. hours, if discharged in three hours, weighs 1258 lbs. for the Planté type and 977 lbs. for the Faure type; the capacities per lb. of weight of cell are 2.8 and 3.6 amp. hours respectively; the capacities per cub. inch of volume of cell are 21 and 35 amp. hours respectively; an automobile with such a battery can run over 15 to 18 miles with the Planté type, and over 24 to 27 miles with the Faure type. The life of a Planté accumulator is 200 discharges, that of a Faure accumulator 120 to 150 discharges. Experiments with good automobiles have shown that 129 to 137 watts are consumed for one ton mile per hour, on good roads without grades. The Planté accumulator should be used to advantage whenever high discharge currents are required and when the length of the trip is of no great importance, while the Faure accumulator is to be preferred if long trips and a light, elegant automobile are wanted and great economy is not required, as in automobiles for pleasure and sport.—*Centralblatt fuer Acc. und El. kunde*, Apr. 1.

Electrolytic Reduction of Potassium Chlorate.—Voege.—An account of a long experimental investigation. The reduction is greater in acid than in alkaline solutions. The amount of reduction varies with the metal used for the electrodes, zinc being more effective than cadmium, and the latter more so than platinum. With zinc and platinum the reduction increases greatly with decreasing current density, while this is not observed with cadmium. The reduction yield is greatly affected by the physical structure of the zinc electrodes, large crystals being associated with a higher efficiency. An increase of temperature greatly facilitates reduction. The reduction depends largely on the strength of the sulphuric acid used, the maximum efficiency being obtained with about 1.5 normal strength. Decreasing the current strength increases the reduction, but this result is possibly due to the change in voltage occurring No electrolytic reduction occurs at the anode in zinc, cadmium and platinum cells, all chloride found there being due to the action of the acid and to diffusion from the cathode cell. Potassium zincate is formed at the cathode by the secondary reaction of potassium hydroxide, electrolytically formed, with the zinc, and the hydrogen resulting from this reaction is used in the reduction, making it possible to obtain an apparent electrolytic efficiency of more than 100%. Copper is only slightly attacked by sulphuric acid alone, but is readily dissolved in the presence of potassium chlorate, and an almost quantitative yield of potassium chloride is obtained. This reduction by copper without electrolysis is about four times that by zinc for equivalent quantities dissolved, although zinc dissolves much more slowly than copper. With copper electrodes the electrolytic reduction is probably less than with zinc electrodes, but this is difficult to establish conclusively on account of the great amount of reduction due to purely chemical causes when copper is used.—*Jour. Phys. Chem.*, December; abstracted in *Science Abstracts*, March.

Bleaching Wood Pulp.—An article on the electrolytic methods. Hermite's apparatus consists of a series of zinc and platinum plates, all zinc plates being connected to the negative terminal, and all platinum plates to the positive. Corbin's apparatus consists of an insulated case filled with the electrolyte, the current being supplied by two platinum electrodes; between these real electrodes a number of insulated platinum plates are suspended, the surfaces of which, although not connected directly with the circuit, act also as electrodes; by adjusting the number of these plates, the voltage can be regulated without the use of the great number of binding screws in the apparatus of Hermite, as they are soon destroyed by the action of the vapors of the electrolyte. The platinum plates last a very long time, if the current is reversed every 12 hours. The electrolyzers installed at Lancey, have three platinum plates and are operated at 120 volts and 150 amperes. In 24 hours 1650 lbs. of pulp can be bleached to a perfect white color. The electrolyte consists of a pure solution of marine-salt of 2.5 Beaumé and lasts very long.—*Elektrochem. Zeit.* March.

Electrolysis.—Tommasi.—A brief account of some experiments. When into a U-shaped tube filled with distilled water, two platinum

electrodes were plunged, connected to the poles of two Daniell cells, no visible effect was produced even after some time had elapsed. If a silver wire is substituted for the positive electrode, at the end of 18 hours a slight quantity of oxide of silver can be found in the distilled water, by the aid of hydrochloric acid. With three Daniell cells the effect is much more noticeable; at the end of 15 minutes the silver begins to dissolve; after 18 hours the whole of the curved part of the tube is coated with crystals consisting of a mixture of silver oxide and metallic silver. Copper also forms a crystalline deposit when it is used as anode. Gold used as anode does not produce any metallic deposit under the action of 8 Bunsen cells.—*Lond. Elec. Rev.*, Apr. 6.

Liquid Ammonia.—FRENZEL.—A long illustrated account of an experimental investigation of some properties of liquid ammonia. It has a very small electric conductivity, in agreement with the law that, with the exception of fused salts, there is no pure substance which is ionized to a considerable degree. The temperature coefficient of the conductivity is 1.9% and decreases, when the ammonia is mixed with impurities, which is analogous to the behavior of water. Ammonia is said to be a weak tribasic acid.—*Zeit. fuer Elektrochemie*, Mar. 22, 29, Apr. 5.

Speed of Formation of Ions.—LE BLANC.—A long abstract of a paper read before the German Electrochemical Society at Frankfort, calling attention to the importance of the speed of formation of ions in electrochemical processes (the speed of formation of ions apparently meaning the number of ions formed from atoms per unit of time). If, for instance, the e. m. f. of a Daniell cell is said to be constant for a given solution and temperature, and independent of the pure zinc and copper used for the electrodes, it is supposed that the speed of formation of zinc ions from zinc atoms and of copper atoms from copper ions is sufficiently great; if these speeds of formation would be small, the e. m. f. would decrease with discharge; if these speeds became zero, the e. m. f. would also become zero; if then a current from an external source would be sent through the cell, no dissolution of zinc and precipitation of copper would be possible, but other reactions would occur, as though the electrodes were inert. The question is whether we know any substances of which the speed of formation of ions varies so that the changes can be measured. One example is nitric acid; silver and copper are not attacked by dilute, pure nitric acid, but are dissolved at once and rapidly without development of hydrogen, if a drop of a solution of nitrite of potassium is added. In a cell consisting of zinc, a solution of zinc sulphate, dilute pure nitric acid and platinum, the difference of potential at the platinum is 0.2 volt with closed circuit, and a lively formation of hydrogen occurs at the platinum; by adding a drop of a solution of nitrite of potassium, the potential difference at the platinum becomes — 1.2 volt and the formation of hydrogen stops; by adding urea and thus destroying the nitrous acid, the former condition is reproduced. The explanation of this phenomenon is based on the double nature of nitric acid; in pure dilute solution it reacts like other indifferent acids with an equal concentration of hydrogen ions; it has also the property of forming hydroxyle or oxygen ions and can therefore act as an oxidizing agent; the speed of formation of these ions varies greatly; while it is very small in pure dilute nitric acid, it increases greatly with the addition of a small quantity of nitrous acid. Among the metals, chromium behaves similarly, as shown by Hittorf (Digest, July 29, 1899); it has been found possible to decrease the speed of formation of the bivalent chromium ions to a minimum, and thus to make chromium a noble metal. He concludes that a general way is thereby opened for making metals noble. Such a result would be more valuable than the old aim of the alchemists to change other elements into gold; it would be of greater importance, for instance, to destroy the property of iron of rusting. This method of making metals noble should not be confused with the passive state of metals. Hittorf emphatically denies that the peculiar behavior of chromium is due to an invisible coating of the oxide.—*Zeit. fuer Elektrochemie*, Mar. 15.

REFERENCES.

Pasted Accumulator Plates.—HOEPFNER.—The first parts of a very long serial. Experiments have so far failed to find a different lighter metal for the lead; it has been the aim of the inventors to find, instead, the best possible geometrical form of the lead plates. The inventions of Planté and Faure are briefly outlined, and the practical defferences between secondary and primary batteries and their theoretical identity are discussed. The real and apparent surface of an accumulator plate are distinguished and the real surface of an electrode surrounded by a liquid depolarizer, the real surface of a positive electrode surrounded by a solid conducting depolarizer, and the real surface of a mixture of carbon and manganese, are briefly discussed. He calls that electrode the positive from which the positive current is flowing into the external circuit at discharge. He makes a comparison of the Faure accumulator with the Leclanché cell, and discusses the question of the active surface of the positive and that of the negative plate of the Faure cell. He distinguishes the contact surface of the active material from the real active surface, and discusses the function and action of the contact surface, especially in the positive Faure plate.—*Centralblatt fuer Accum. und Elem. kunde*, Jan. 1, 15, Feb. 15, Mar. 15.

Dry Accumulator.—KIESERITZKY.—An article on the portable watt "dry" accumulator (Digest, Feb. 24).—*Elektrochem. Zeit.*, March.

Accumulator Jars.—HOEHN.—A brief article on the construction of the jars or boxes for accumulators, and the materials used for that purpose.—*Elektrochem. Zeit.*, March.

Electric Bleaching.—ENGELHARDT.—An article giving a summary of the different methods for the commercial production of hydrochlorides by electrolysis and its application for bleaching.—*Elektrochem. Zeit.*, March.

Potassium Chlorate.—BROCHET.—A French Academy note on the manufacture of potassium chlorate by electrolysis of potassium chloride in presence of potassium chromate.—*Comptes Rendus*, Mar. 12; abstracted in Lond. *Elec.*, Apr. 6.

Chlorate.—LAUDIN.—A long abstract of a paper discussing the different methods of the electrolytic production of chlorate.—*Zeit fuer Elektrochemie*, Mar. 22.

Electrochemistry in 1899—KRUEGER.—The conclusion of his long article (Digest Mar. 10), dealing with the construction of electric furnaces, with the development of the alkaline industry, and other branches of inorganic chemistry, and with the progress in analytic chemistry and organic electrochemistry. Most of the descriptions of new processes are taken from patent specifications.—*Electrochem. Zeit.*, March.

Electrochemistry.—BODENSTEIN.—The first parts of his inaugural address as instructor in electrochemistry in Heidelberg, dealing with the electro-chemical processes. He gives an outline of the methods used in electrolytic analysis, in electroplating and electrometallurgy. The theory of the "decomposition pressure," defined by Le Blanc as the minimum potential difference at the cathode, at which electrolysis is possible, is briefly given.—*Phys. Zeit.*, Mar. 17, 24.

Sweden.—CARLSON.—A longer abstract of his paper on the electrochemical industry in Sweden, noticed in the Digest March 10.—*Zeit. fuer Elektrochemie*, Mar. 15.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Standards of Light.—PETAVEL.—Continuation and conclusion of his long illustrated paper noticed in the Digest Mar. 31 and Apr. 14. The probable variation in the light emitted by molten platinum under the standard conditions, is not above 1%. With more perfect apparatus and with changed experimental conditions the accuracy of this standard would be increased. Physiological considerations fix a limit to the accuracy of photometric observations. It is not impossible that the accuracy of the platinum standard may attain or even surpass this limit.—Lond. *Elec.*, Mar. 30, Apr. 6.

Electric Units.—W. S. F.—A note on the proposal of Fessenden to get rid of the 4π factor. He agrees that it leads to simpler equations, but is initially more complicated for teaching a class. The most valid objection to the present recasting of our systems of electrical units is that we have no assurance that a new system would stand. "For, in the first place, a new electrical relation must be discovered before we can settle upon one system of units; and, in the second place, we do not know even whether electric current and curl of magnetic field are identical or merely proportional, as has been pointed out by J. J. Thomson."—*Science*, Apr. 6.

Polarization Photometer.—MARTENS.—A description of an instrument the working parts of which are contained in a tube which can be turned about its axis, the angle being measured on a circular scale. The rays of lights to be compared are admitted through an objective, a Wolleston prism, a biprism, an analyzing nicol, and two lenses forming a Ramsden's eyepiece. The adjustment for equality

of the two halves of the field is effected by turning the analyzing nicol through an angle indicated on one of the scales of the instruments.—*Deutsch. Phys. Ges. Verh.*, 1, p. 204, 1899; abstracted in *Science Abstracts*, March.

Wehnelt Interrupter.—PRICE.—An illustrated description of a working form of the Wehnelt interrupter, which is formed of a glass jar with a hard rubber cover, to which is fastened a lath strap three inches wide, passing down one side and across the bottom. Two holes in the cover are fittel with perforated rubber stoppers through which pass ordinary clay pipe-stems, about six inches long. Inside each is placed a piece of brass wire with a platinum tip about one inch long, soldered to it with hard solder. One tip is No. 16 gauge, and the other No. 20. The brass wire extending beyond the pipe-stem has a piece of flexible lamp cord connecting it to a binding post. The platinum tips are adjustable with great convenience through the pipe-stems and the whole is adjustable through the rubber corks. The object of the two sizes of pipes is to get variation of ampereage through primary and rapidity of interruption.—*Elec. Rev.*, Apr. 11.

Cable Testing.—LEEDS.—A well-illustrated description of a cable testing apparatus built for the Standard Underground Cable Company. It is intended to cover all the tests which are made on cables, in industrial practice, including capacity, insulation resistance, conductor resistance, and the location of faults, by the Varley and Murray loop mehods. A special switch is used by means of which the changes in connection, necessary for the different tests, can be made with a single motion, and a pointer indicates when the desired connections are made. The various instruments are mounted upon a new type of hard rubber insulating post, which insures perfect insulation even in very damp weather. The individual parts of the apparatus are described, and an outline is given of the different methods of measurement.—*Biddle's Bull.*, March.

Galvanometer.—An illustrated description of Sullivan's universal galvanometer for marine purposes.—*Elek. Zeit.*, Mar. 29.

New Application of Price's Guard-Wire in Insulation Tests.—AYRTON and MATHER.—The illustrated Physical Society paper, an abstract of which was noticed in the Digest, Feb. 24.—*Phil. Mag.*, April.

Photometry.—An illustrated article of a general nature.—*Sc. Amer. Sup.*, April 14.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Telephonic Experiment.—PIERARD.—A description of a curious experiment which he made together with Banneux. A metallic disc was clamped in a wooden case in the same way as the diaphragm of a telephone. At its centre a piece of platinum was soldered, and a platinum-tipped screw was adjusted at such a distance behind the disc that notes sung into the mouthpiece produced contacts between the two platinum surfaces. Then the disc and point were connected in circuit with a telephone receiver, without the interposition of a battery, pure notes sung in front of the disc were reproduced in the receiver. Further experiments showed that this was not due to what may be called the string telephone effect, as it ceased on short circuiting the disc and point, and the intensity of the sound was increased by transmission through the medium of an ordinary telephone induction coil. He thinks that the e. m. f. producing the current is merely the contact e. m. f. of two dissimilar metals, the clamped disc and the platinum point, as the result is considerably affected by varying the metal of which the disc is made; the effect was repeated after precautions were taken to avoid temperature differences and their consequent thermo-electric effects. The phenomenon seems therefore to be attributed to nothing but a piezo electric e. m. f.—*Bull. de la Soc. Belge d'Elec.*, February; abstracted in Lond. *Elec.* and *Elec. Eng.*, April 6.

Motions of Telephone Diaphragm.—SHAW.—A brief abstract of a British Physical Society paper, describing a very sensitive micrometer consisting of a system of levers and a spherometer screw; he used it to measure the motion of the centre of a telephone diaphragm. He drew a curve showing the relation between current strength and diaphragm displacement, and by exterpolation he finds that the movement corresponding to the least audible sound is 0.37 micromillimeter. A motion of 50 micromillimeters gives comfortable sounds, 1000 uncomfortable sounds, and 5000 an unbearably loud noise.—Lond. *Elec. Rev.*, March 30.

Some editorial notes on these experiments. The motions of the centre of the disturbed plate do not correspond to the maximum displacements, as the presence of a magnet pole in close proximity to the centre, the absence of absolute uniformity in the thickness, and the irregularity in the clamping tend to move the point of maximum disturbance away from the centre. Much instructive information is expected from a curve showing the variation of the displacement along a diameter.—Lond. *Elec.*, March 30.

Simultaneous Telegraphy and Telephony.—WALLOCH.—A long illustrated paper on Van Rysselberghe's method, and on its application to the lines between the fire engine stations in Berlin. The connections are given in diagrams and several of the apparatus are illustrated.—*Elek. Zeit.*, March 22.

Telephone Charges.—An editorial on the tendency in different countries to arrange the telephone charges in such a way that different rates are charged according to the number of calls.—*Elek. Zeit.*, March 15.

Cable Steamer.—A brief description of the new cable repairing 2400 tons steamship John Pender, of the Eastern Telegraph Co.—Lond. *Elec.*, March 23.

MISCELLANEOUS.

Ducasse Electric Furnace.—A description of a furnace, circular in plan, with a movable hearth, the whole of which acts as the negative electrode. A tap-hole is provided to run off the liquid products, and in the upper portion of the furnace is a side flue provided with a sight-hole and cleansing door; through this flue the heated furnace gases are carried to a chamber in which the furnace charge is preheated. The furnace is surmounted with a domed cover, and perforated with charging doors, and with four apertures, through each of which passes one of four carbon rods forming the positive electrodes. These electrodes are supported from above in such a way that their position may be regulated automatically or at will. By means of a motor working on a shunt from the main circuit, a rotary current distribution causes the main current to pass through each of the electrodes in succession 3,000 times a minute, contact with any one carbon not being broken until that with the next has been made. so that sparking is avoided. In this way there is produced in the hearth of the furnace, an arc which practically rotates at 3,000 revolutions per minute.—*Ind. Electrochim.*, November; abstracted in *Science Abstracts*, March.

Magnetic Separation.—LANGGUTH.—An article in which he concludes that the best economy in magnetic separation processes is obtainable under the following conditions: Generation of magnetic fluxes of high density and small m. m. f.; passing the material to be separated at a uniform but very small distance from the magnetic pole; adjustable speed; separation in a homogeneous field.—*Zeit. fuer Elektrochemie*, Apr. 5.

Conductivity of Nerves.—LEDUC.—A French Academy note describing an experiment which shows that there is a difference in conductivity of the human nerves in accordance with the direction in which a current travels along them. The muscle contracts when the current is centripetal, i. e., when it passes away from the nerve centres. It contracts little or not at all when the current is in the reverse direction.—*Comptes Rendus*, Mar. 12; abstracted in Lond. *Elec.*, Apr. 6.

E. M. Fs. of Muscle.—MENDELSSOHN.—An account of experiments upon the e. m. fs. developed in a muscle during its contraction, and an application to the study of various paralytic conditions. He finds the most promising results in the examination of the diphasic wave of an e. m. f. set up in a muscle when its nerve is artificially stimulated. In a paralyzed muscle the diphasic e. m. f. may cease to be proportionate to the degree of voluntary power which survives. In a muscle which is paralyzed but preserves its electrical irritability, the two phases are evident and are still seen, even when there is atrophy of the muscle fibres. A notable decrease in the second phase in a paralyzed muscle is a sign of approaching degeneration. In certain cases of atrophic paralysis a total disappearance of the second phase may be observed.—*Arch. d'El. Med.*, January; abstracted in *Science Abstracts*, March.

Copper.—A statistical table, giving the figures for the copper production in the different countries of the world for 1899 and a comparison with 1898. The total foreign production was 195,088 long tons in 1898 and 208,662 in 1899; that of the United States 239,241 in 1898 and 265,156 in 1899.—*Eng. & Min. Jour.*, Apr. 7.

Paris Exposition.—A note stating that "the largest example of English electrical engineering plant" will be a continuous current dynamo of Siemens Bros., giving 2700 amp. at 500 volts. The aggre-

gate output of the English dynamos will be 1900 kilowatts, those of the French and of the German machines being 8000 and 4000 kilowatts respectively. Machines of over 10,000 kilowatts are installed on the three-phase system, while the continuous current system comes next with slightly more than 8000 kilowatts. There will be a small exhibit of two-phase machinery and the single-phase alternaters will have an aggregate output of about 1250 kilowatts.—Lond. *Elec. Eng.*, Apr. 6.

REFERENCES.

Electric Igniters.—PANAMOLO.—An illustrated article giving hints concerning the construction, care and inspection of electric igniters for gas and gasoline engines.—*West. Elec.*, Apr. 14.

Atmospheric Electrification and Human Pathology.—PERRY.—An article on the observations of Schlieb, noticed in the Digest Apr. 14. —*Nature; Sc. Amer. Sup.*, Apr. 21.

Historical.—BROOKS.—An article on electric pioneers of San Francisco, giving personal reminiscences from the seventies.—*Jour. of Elec.*, March.

Metal Market.—Four diagrams showing the fluctuations of the price of copper, tin, zinc and iron during the month of March.—Lond. *Elec. Rev.*, Apr. 6.

Union Electric Co.—A brief summary of recent work and of the financial conditions of this prominent German company which is affiliated with the General Electric Co. of this country.—*Elek. Anz.*, March 18.

Directory of Electrical Societies, Etc.

NORTHWESTERN ELECTRICAL ASSOCIATION. Next meeting, Waupaca, Wis., June 26, 27 and 28, 1900.

CHICAGO ELECTRICAL ASSOCIATION. Next meeting, May 4. Paper "Road Test on Street Railway Motors," by Prof. P. B. Woodworth.

CANADIAN ELECTRICAL ASSOCIATION. Next meeting, Ottawa, Ont., June 27, 28 and 29, 1900.

AMERICAN STREET RAILWAY ASSOCIATION. Next meeting, Kansas City, Mo., Oct. 16, 17, 18 and 19, 1900.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Next meeting, Chicago, May 22, 23 and 24, 1900.

NATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Next meeting, Pittsburg, Pa., Sept. 25, 26 and 27, 1900.

AMERICAN ELECTRO THERAPEUTIC ASSOCIATION. Next meeting, New York, Sept. 25, 26 and 27, 1900.

The E. P. Storage Battery.

BY H. S. MARTIN.

Among the latest batteries to be presented to the public is that manufactured by the Electric Power Company, of New York, some views of which are given herewith. This type shows some very radical departures from the ordinary type of storage batteries. It is built up of composition plates, having the usual form of pockets therein, which contain the active material. The foundation plate may be of any desired size, but in the particular cell here illustrated it has an area of 5½ ins. x 8½ ins. and a thickness of ¼ in. and 5-16 in. The automobile sizes are slightly longer and give also an arithmetically larger output, the basis of the output being practically the cubical contents of active material in the plates.

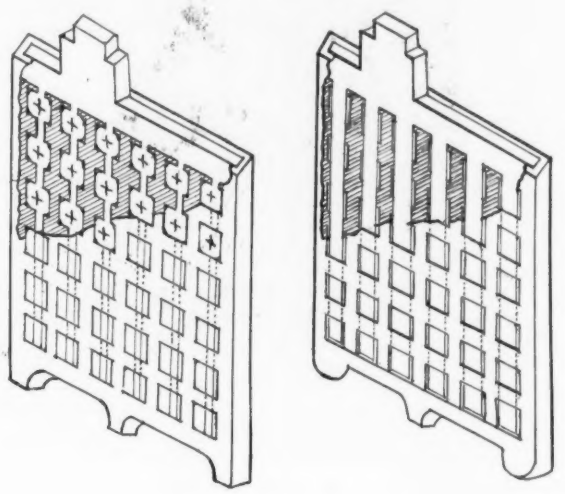
The finished cell gives in actual use 6½ amperes per pound of finished battery, a 35-pound cell giving 230 ampere-hours. The theoretical output of peroxide of lead in a storage battery is 96 ampere-hours per pound of peroxide, and a cell of this type of 35 pounds weight shows 33 ampere-hours per pound, being 34 1-3 per cent. of the theoretical energy. The peculiar make-up of the cell, and the situation of the centrally-located conductor, permits this unusual return.

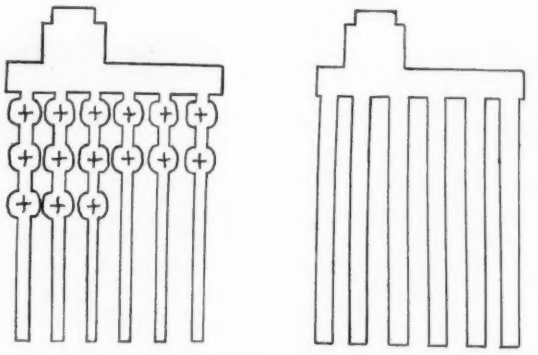
The plate is formed up from a proper mold, and at the upper end is left a pocket, which runs almost the entire width of the plate, and, say, three-quarters of an inch deep, its width or thickness being sufficient to properly carry the upper portion of the grid used as a conductor. The conductor projects downward into the plate, occupying the centre of the pockets, in such a manner as that the active material is always in contact with the legs, which are of sufficient thickness to form a properly-balanced conductor—large enough to take care of the current flowing through it, and yet so reduced as to eliminate all useless weight.

Various forms of this grid-like conductor have been used, the one most preferred being a flat leg, practically broad enough to fill the pockets. Fig. 2 shows a plate carrying a flat-leg grid, and is broken away to show its position in the plate. Fig. 4 being a representation of the grid ready for putting into the plate. Round conductors have been also used, being flattened out in the pockets, so as to produce a broadened surface, which the active material surrounds, thus giving the same surface as the flat form, and, in cases where the cells are necessarily handled much, being slightly stiffer and less liable to loosen the active material. Fig. 1 shows this form of grid in place, the legs being flattened in some of the pockets; and Fig. 3 represents the grid also partially flattened, as shown in the plate. The flat and round grid contain about the same amount of conductor.

From their construction, these plates weigh much less than the same amount of lead, though of the same utility in supporting the active material. Compared with lead plates, this plate of 5½ x 8½ x 5-16ths, and weighs but 4½ ounces, while a lead plate of the same size weighs nearly 2½ pounds. As the lead in the plate is unnecessary for any purpose except for a support, except perhaps 10 ounces as conductor, this form of plate necessarily results in a saving of weight.

The centrally-located conductor is placed at a point where it is





FIGS. 1, 2, 3 AND 4.—VARIOUS FORMS OF GRIDS.

acted upon centrally and uniformly and not from the surface, as in the case of lead-plate batteries. This gives the material a chance to work uniformly and evenly and to give a higher rate of discharge than is possible with the ordinary arrangement now in use, of having the support of lead with an uneven discharge occurring at all points of contact between support and conductor, with the active material. sulphating at the junction of the plates with the active material cannot take place, as with ordinary plates, and the depreciation is cut down to the minimum. This construction also eliminates nearly all inactive material. There is no metal present except such as is used for conducting rods in the centre of the box of active material, all the rest of the plate being made up of a non-conducting material, light in weight, inactive in character, flexible and unaffected by the electrolyte.

Compared with pasted plates, cells constructed on this principle weigh for identical output of electrical energy but 60 per cent. as

much. In getting the E. P. cells into a commercial shape, tests were made in comparison with pasted cells, the E. P. and other cells being connected in straight series, all charged, discharged and tested under

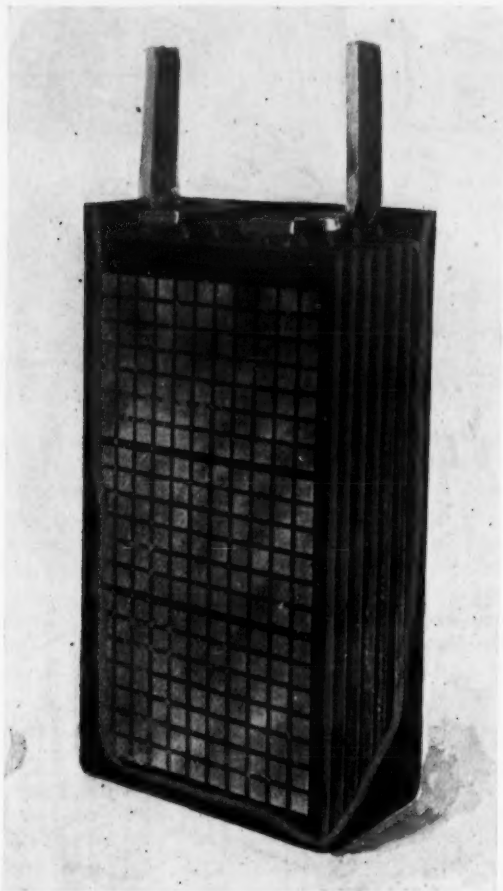


FIG. 5.—CELL OF E. P. STORAGE BATTERY.

exactly similar conditions and circumstances, each cell being cut out as it reached the working limit. The general result showed in stationary batteries over 100 per cent. more output, weight for weight of cell. In automobile cells the general average is about 80 per cent. increase over other cells of the same weight.

In constructing automobile cells it has been considered best to keep to sizes low in ordinary use, and to do this, the cells are made up of 5, 7, 9 and 11 plates. The usual size in use on pleasure vehicles, 7 plates, can be used as comparison. A pasted, 7-plate cell weighs, when charged 21 pounds, and is rated to give 90 ampere-hours at a 4-hour discharge, being 22½ per hour. In practical use, this is somewhat diminished, being nearer 75 ampere-hours, as a practical delivery, showing about 65 per cent. efficiency. A 7-plate, E. P. cell weighs when charged 21 pounds, and is claimed to give 110 ampere-hours at a similar discharge, having 85 per cent. efficiency. A wagon with an equipment of pasted cells weighing 23 pounds each, with a delivery of 75 ampere-hours sufficient to drive the wagon, say, 25 miles, would with an equipment of E. P. cells weighing 21 pounds each, and with an ampere delivery of 110 hours, be driven 50 miles. Of course, by the saving which can be effected in the weight of vehicle necessary to carry the batteries, a further increase in distance run would be made, as the cells in one case weigh 1232 pounds and in the other but 924 pounds.

Under short-circuiting tests, these cells show no distress, and recover very rapidly, it being apparent from experience that the internal resistance is cut down to the minimum. A battery weighing 35 pounds, after having been short-circuited repeatedly and finally discharged on a dead-short-circuit for 25 minutes, until its voltage was reduced to 0.01 volt, took but 5 minutes to recover to 1.90 volts, notwithstanding the strain to which it had been subjected.

The makers of the cells claim for them that they have many advantages over other types now on the market; are practical in composition and make-up, easy on construction and manipulation, lighter in weight, output for output, will stand heavier strains and overloads and have a longer life than any yet produced.

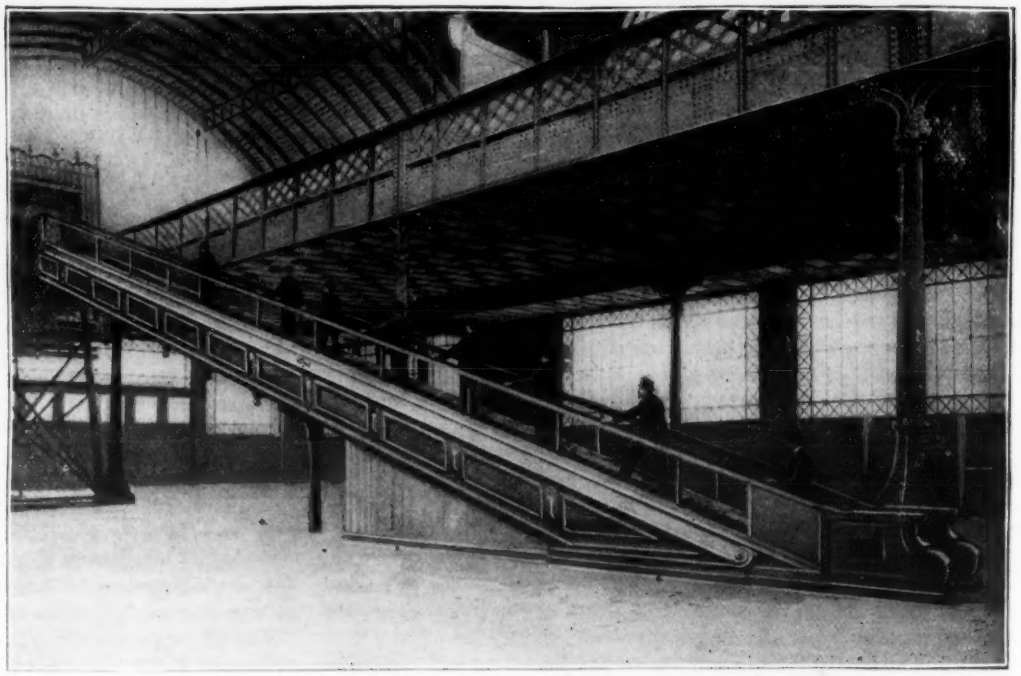
Many of the tests while the battery was being gotten into commercial shape for presentation to the public were made by Mr. L. R. Knowles, E. E.

Inclined Elevators at the Paris Exhibition.

The illustration shows one of the five inclined elevators (Reno system) now in operation at the Paris Exposition. The purpose of these elevators is to make it easy for the patrons of the exposition to reach the galleries, which are very extensive and important. Unlike the Chicago Fair, the Paris Exposition had but a limited ground area upon which to build, and it was therefore decided to add a very large area by building galleries where exhibits could be shown.

The known dislike of the general public to climbing long flights of stairs (the height of the galleries being 23 feet) made it imperative to have some means of elevating passengers mechanically. After careful investigation the Reno system was adopted, and the company getting the concession was allowed to make a charge of 2 cents per passenger. While this sum is small in itself, in the aggregate it amounts to considerable, as the capacity of the elevator is 3000 passengers per hour, and the cost for power is less than one-hundredth of a cent per passenger. Of course, a certain percentage of the profits is to be paid to the exposition.

Nine of these Reno elevators are now in operation in New York and Philadelphia, and estimates for 100 machines have been requested by the managers of the New York elevated roads to be installed at their important stations. It is very apparent that the stair climbing to the elevated stations is considered a great objection by the traveling public, and the last report of the Manhattan Railway shows a falling off of $1,750,000 in annual net earnings due to the competition of the surface lines. The Reno inclined elevator has now been on the market for two years, and during that time the various machines have carried over ten million passengers without accident.



VIEW OF ONE OF THE INCLINED ELEVATORS.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—The sharp declines of the steel industrials following the sudden announcement that the American Steel & Wire Company had shut down 11 of its mills, and the exaggerated reports about cutting of prices in the steel business caused a depressed and unsettled feeling in speculative securities. The general market, however, stood the shock very well, and since the first announcement, has shown an irregular tendency toward recovery. Railway earnings continue to bear strong testimony to the fact that whatever may be the variations in the iron trade, other lines of the country's business continue in full volume and that the distribution of products is still on an immense scale. For the first week of April the earnings of 71 roads amounted to $8,790,619, 12.8 per cent. larger than in the same week a year ago, while for the second week of April 48 roads report earnings of $6,022,001, a gain of 11.6 per cent. over 1899. Bank clearings in the United States reflect the effect of the past holiday season in an aggregate of $1,725,855,008, a decrease of 8 per cent. from the previous week and of 12 per cent. as compared with the same week a year ago. The business failures for the week as reported by Bradstreet's were 161, as compared with 152 the week previous, 187 the same week a year ago, 224 in 1898, 216 in 1897 and 240 in 1896. The principal activity in trading was in American Steel & Wire stock, the common shares declining from 51 to 40 and the preferred from 85 to 75¾. Both classes, however, regained some of the losses later in the week. General Electric was strong, rising to 140 up to Friday, when it fell off in face of the excellent showing made in the annual report, which is published elsewhere in this issue. In the traction group there was some activity in both Metropolitan and Brooklyn Rapid Transit, but these stocks were not especially prominent. In the market for outside securities most of the changes were on the side of declines, although there was no particular reason for the declines other than that traders saw fit to depress the market. General Carriage was fairly active, and after some irregular movements closed about unchanged for the week at 8 bid. Electric Vehicle was quiet until the close of the week, when 500 shares of common were sold at between 40 and 38. The stock lost 3 points net, closing at 37 bid. New York Transportation sold up to 12¾ and subsequently declined to 12⅛, ending the week at 12 bid, a net gain of half a point. The movements of the various electrical stocks are given below. The sales of General Electric for the week were 19,350 shares, the closing quotation being a net gain of 3½ per cent. The highest mark reached was 140¼ and the lowest 133½, the closing quotation being 139. Western Union Telegraph closed the week with a net loss of 2 points. The highest price was 82½ and the lowest 80⅝, closing at 81. The sales of Brooklyn Rapid Transit were 137,330 shares, the highest, lowest and closing quotations respectively being 77⅝, 77¼ and 75; the net result of the week's trading being a loss of 3¾ points. Metropolitan Street Railway closed at 157½. This stock also suffered a net loss on the week's business of 3¼; the highest price reached was 165¾ and the lowest 157¼. Among the miscellaneous list, Telegraph, Telephone & Cable of America closed at 4; Electric Boat, 25; do., pfd., 40; Electric Vehicle Company, 37; do., pfd., 80; General Carriage, 8¼; New England Transportation, 5½; N. Y. Elec. Vehicle Transportation, 12; Safety Car Heat & Lighting, 120. Boston closing prices were as follows: American Bell Telephone, 328; General Electric preferred, 137; Mexican Telephone, 2⅝; Westinghouse, 46; do. pfd., 61. In Philadelphia Electric Storage Battery closed at 90; do. pfd., 92; Electric Company of America, 12¼; General Electric Automobile, 1; and Penna. Electric, 4½.

FOREIGN AUTOMOBILE COMPANIES.—Two foreign concerns, both to manufacture automobiles, were incorporated at Dover, Del., recently. They are the British Motor Coupe Company, comprising British capitalists, with New York connections, to buy, sell, and deal in motors and motor carriages, with a capital stock of $3,000,000, and the Anglo-American Motor Company of New York, to deal in motors and motor vehicles, with a capital of $750,000.

BELL TELEPHONE DIVIDENDS.—A Boston despatch states that the directors of the American Bell Telephone Company have decided upon the dividend policy of the American Telephone & Telegraph Company. Regular dividends will be paid of $6 per share per annum with extra dividends of $1.50 per annum, equivalent to $15 per share on American Bell Telephone Company stock, the present rate.

TELEPHONE SYNDICATE'S PLANS.—A financial paper states that a syndicate of ten New York capitalists is said to be formulating a plan for a trunk telephone line from Boston to Chicago with $50,000,000 back of the scheme. An effort will be made to purchase the New England Telephone & Telegraph Co. and part of the American Bell system. The proposed rate from Boston to Chicago is $2.00.

DIVIDEND.—The Bell Telephone Company of Philadelphia has declared a dividend of 2 per cent. payable April 27. The Chicago Edison Company has declared a regular quarterly dividend of 2 per cent., payable May 1. The Electric Illuminating Company of Boston has declared the regular quarterly dividend of 2½ per cent., payable May 1.

THE AUSTIN DAM TROUBLES.—The Water and Light Commission of Austin, Texas, have extended an invitation to the holders of the outstanding water and light bonds of that city, amounting to $1,300,000, to meet with them in friendly conference with a view of arriving at an adjustment of this debt. The destruction of the great dam waterworks and electric light and power plant has complicated matters.

GOLD AND STOCK BONDS.—The Western Union Telegraph Company has completed arrangements for extending $500,000 5 per cent. bonds of the Gold & Stock Telegraph Company for five years from May 1, 1900, at 4½ per cent. The bonds were originally 6s.

Commercial Intelligence

THE WEEK IN TRADE.—There was somewhat more irregularity in the trade and price situation, due to various causes. The basic conditions of trade, however, remain favorable. Heavy rains and cool weather early in the week had a depressing effect on trade and collections, but, with the advent of a warm spring temperature, improved conditions of retail demand, which is at present a most important element in the general trade situation, have been noted. In regard to the American Wire and Steel perturbation and the alleged oversupply of iron and steel goods, the claim is made that large stocks of wire exist mainly on producers' hands and that jobbers and retailers' stocks have been kept low by abnormally high prices. The shutdown of the mills has had an unsettling effect upon the general demand, and interfered somewhat with new business. Relatively the best trade reports during the week, Bradstreet's says, came from the Pacific coast, where general business has improved and Alaskan and Asiatic business is increasing. In the copper market a good consumption is reported, both at home and abroad, and manufacturers report a satisfactory incoming of orders. It is likely that large orders will come from Europe, as the manufacturers there are poorly supplied. Lake is quoted at 16.90@16.95c; electrolytic in cakes, wirebars and ingots, 16.75@16.85c; cathodes, 16½@16⅝c; casting copper, 16⅝c.

AIR BRAKES AND STREET CARS IN GERMANY.—Henry Hermann Boker, of H. H. Boker & Co., manufacturers and contractors of railroad material, of Berlin, sailed on Tuesday for Bremen by the North German Lloyd liner Kaiserin Maria Theresia, after a sojourn in this country for six weeks. On the eve of his departure Mr. Boker said that he had made arrangements with the Standard Air Brake Company of this city for the manufacture of that company's air brakes at his firm's steel and iron foundry at Reinsheid, situated near Cologne-on-Rhine. "This agreement," he said, "has been partly actuated because of the German Government's decision that all surface cars must have air-brake equipments. Such being the case, several thousand will be required, and it is cheaper to manufacture the American brakes—under royalties—in Germany than to import the equipments from this side and thus incur the heavy custom duty on manufactured articles of this description." Continuing, Mr. Boker said: "As I have been particularly struck with the artistic decoration of the interior of your cars, I have concluded arrangements with the St. Louis Car Company whereby I will import the woodwork portion of some 100 cars which my firm is now building at our Berlin car shops for the Berlin Street Railway and for the principal electric road at Frankfort-on-Main, and as w German manufacturers have not yet arrived at anything like the artistic merit and neatness which Americans display in the wood part of your cars, I look to place a number of important orders with your car manufacturers in the near future. The contract which I have just placed with the St. Louis people is worth close on $50,000."

THE BERLIN IRON BRIDGE COMPANY, of East Berlin, Conn., has made an extensive purchase of real estate at Pittsburg, Pa., and has already started on a new plant to be located at that point. It is the intention that this plant will be in complete operation by the first of July, as the orders for the machinery equipment have been placed for some months. The entire plant will be equipped with new machinery, which will be of the heaviest and most modern design, and the orders have been placed with the Hilles & Jones Company, of Wilmington, Del.; the Cleveland Punch & Shear Works Com-

pany, of Cleveland, Ohio; the Niles Tool Works Company, of Hamilton, Ohio, and the Brown Hoisting & Conveying Company, of Cleveland, Ohio. The hydraulic plant will be very elaborate, and will be furnished by William H. Wood, of Media, Pa. The floor surface of the main shop is to be controlled by 23 traveling cranes, of various sizes and design, of the heaviest capacity, all furnished by the Chisholm & Moore Manufacturing Company, of Cleveland, O. The fuel used will be naural gas, the engines being furnished by the National Meter Company, of New York, N. Y. The machinery will be operated throughout by electricity, the generators and motors being furnished by the General Electric and Westinghouse people. The Berlin Iron Bridge Company intends that this plant shall be the most perfect and complete of its kind in the world. No pains or expense have been spared in making it such, and the company is now taking contracts to be filled at the new plant for delivery after July 1. The capacity will be from 3000 to 4000 tons per month.

THE NATIONAL AUTOMOBILE & ELECTRIC COMPANY.—Work on the new factory building of the National Automobile & Electric Company at Indianapolis, Ind. is progressing at a rapid rate, and it is expected that the building will be turned over to the company on May 7. This concern, when in operation, will be the second largest establishment in the country devoted exclusively to the manufacture of automobiles, and will have a capacity of ten complete vehicles a week. The building will be of modern construction throughout, with a view to the rapid and economical production of vehicles, and the comfort and safety of employees. It will be 325 feet long, 75 feet wide and two stories high. There will be, in addition, a power house 50x50 feet. A railroad siding 560 feet long will bring the level of the cars to a platform 48 feet in length extending outside from the receiving and shipping room door. The coal for the power house can be handled practically from the cars to the front of the boilers. The latest patterns of high-class labor-saving machine tools will be employed at the works, and these have already been contracted for delivery in Indianapolis. The company will manufacture electric vehicles, of which there will be seven styles for business and pleasure use. These vehicles will be of new and improved types, embodying many novel features. It is stated that other motive power will be taken up later by the company. The directors of the company are Albert E. Metzger, H. T. Hearsay, Robert Martindale, A. C. Newby, C. E. Test, Philip Goetz and L. S. Dow.

EXPORTS OF ELECTRICAL MATERIAL.—The following were the exports of electrical material from the port of New York for the week ended April 21. Argentine—29 cases electrical material, $1554; 36 cases electrical machinery, $3622. Bristol—7 cases electrical material, $1618. British Australasia—64 cases electrical material, $5257. Bremen—4 cases electrical material, $500. Brazil—283 cases electrical material, $16,002. Berlin—4 cases electrical machinery, $60. Chili—3 cases electrical material, $101. Central America—157 cases electrical material, $6317. Cuba—50 cases electrical supplies, $80; 30 cases electrical material, $10,009; 226 cases electrical machinery, $36,210. Dublin—3 cases electrical material, $125. Glasgow—199 cases electrical machinery, $20,098; 19 cases electrical material, $1554. Genoa—6 cases electrical material, $50. Havre—145 cases electrical material, $8361. Hamburg—31 cases electrical material, $5023. Liverpool—94 cases electrical material, $4601; 4 cases electrical machinery, $619. London—75 cases electrical material, $4832; 75 cases electrical machinery, $6117. Mexico—221 cases electrical material, $4991. Manchester—1 case electrical machinery, $60. Newfoundland—1 case electrical machinery, $19. Philippines—50 cases electrical material, $525. Peru—20 cases electrical material, $2532. San Domingo—6 cases electrical material, $57. Southampton—13 cases electrical material $616. U. S. Colombia—2 cases electrical material, $248.

THE FOSTER ENGINEERING COMPANY, Newark, N. J., is preparing to build a new factory on Monroe Street in that city. The principal business of the company is the manufacture of steam pressure regulators. It is at the present time working on an order for the Danish navy, and it has fitted out a large number of the vessels of the United States navy with its regulators. Many of these regulators are used in electric light plants. The company is now working on one of the largest valves ever made, for the Carnegie steel works at Pittsburg. It has just finished a large valve for the Krupp gun works at Essen, Germany. The company has a factory in Manchester, England, and offices at Paris, Berlin, Budapest and other European cities.

THE E. W. BLISS COMPANY, Brooklyn, N. Y., is extending its work by the erection of new machine shops, erecting shop and foundry. The enlargement will increase the producing capacity of the already large plant about one-third. For the last two years the company has found its capacity much too small for its possible business. The machine shop plans are prepared and as soon as some of the old buildings can be torn down the work of erection will commence. The plans for the foundry show that it has a capacity four times what it is at present. The company's trade, both domestic and foreign, is held up to such an extent that it sees no other way out of it but to increase its plant in this manner.

THE LOZIER MOTOR COMPANY, which was organized last year to manufacture gasoline launches and engines, has outgrown its present quarters in Toledo, Ohio, and is desirous of securing a location on the sea coast. The company his decided to go into the extensive manufacture of motor vehicles of the prevailing types—steam, gasolene and electric—and a very large plant will be erected for this purpose. Mr. H. A. Lozier will be at the head of the new enterprise and will give his entire attention to developing its interests. Mr. George H. Burwell, formerly superintendent of the Lozier bicycle factories, will supervise the mechanical end of the business.

MUNICIPAL TELEPHONE SYSTEM IN CHICAGO.—City Electrician Ellicott, of Chicago, is advertising for bids on 1500 telephones for the new municipal telephone system to be established primarily for the use of the police and fire departments. Later he will ask for prices on enough insulated wire to make the necessary connections. The conduits have been completed so that, with the purchase of the apparatus, no delay will be met in installing the system. The Chicago Telephone Company has had an annual rental of $8000 from the city.

ELECTRICAL MACHINERY FOR AUSTRALIA.—Manufacturers desiring representation in Australia have an excellent opportunity to make arrangements with the firm of Splatt, Wall & Co., whose places of business are situated in Perth, West Australia, and Melbourne, Victoria. Mr. Wall is at present visiting America and is open for negotiations to represent firms making electrical machinery and appliances. Letters can be addressed to Splatt, Wall & Co., c/o Messrs. Flint, Eddy & Co., Broad Street, New York.

TELEPHONE MATERIAL.—The Western Electric Company has just received an order for a switchboard, telephones and telephone material from the Krawjewski-Pesant Company, of New York and Havana, which concern has been awarded a contract by the municipality of Havana for the supply of all the telephonic and telegraphic material and equipment requisite for the Cuban capital. It is said that the Havana municipality will eventually spend about $50,000 for telephone material.

THE E. P. ALLIS COMPANY, Milwaukee, Wis., is building 43 blowing engines from 90 to 110" blowing tub. These engines are of an extraordinary size, as the largest built until a short time ago was 84 inches. The Allis Company has already installed up to 100 inches in the Carnegie works. This company's foreign business is growing tremendously, and the size of its engines is becoming so large as to cause wonderment as to where the capacity of the blowing engines being built will stop.

WESTINGHOUSE CONTRACT FOR PARIS.—Information comes from Pittsburg that the Westinghouse Electric & Manufacturing Company has closed contracts for the equipment of the Metropolitan underground railway of Paris and the suburban lines of the western railroad of Paris. The company will also equip a large power house for supplying all the surface railroads of Paris with electric power.

CRANES FOR JAPAN.—The Uraga Dock Company of Yokohama is now in the market for the purchase of both electrical and steam travelling cranes having an average capacity of 40 tons. The operators of the principal ship-building yard at Kobe are also about to equip their yard with large cranes. These are reported to be the first inquiries for big hoisting machinery ever received in this country from Japan.

THE HAWLEY DOWN DRAFT FURNACE COMPANY, of Chicago, has recently received orders from five different sources in Japan for the supply of eight down-draft furnaces, which will be utilized in electric light and other industrial plants in Yokohama and Tokio. The aggregate value of these orders is stated to exceed $6000.

STORAGE BATTERIES FOR HONOLULU.—Sipe & Sigler of Cleveland have recently completed a shipment of $40,000 worth of storage batteries to Honolulu, Hawaii. The batteries will be used in a shipment of 80 automobiles recently made by the Woods Motor Vehicle Company of Chicago, which is introducing its vehicles in our new island possessions.

WESTINGHOUSE, CHURCH, KERR & CO. have recently made among other sales of mechanical stokers 5000 additional horse-power to the Consolidated Traction Company, Pittsburg; 1500 horse-power to Scoville Manufacturing Company, Waterbury, Conn.; 750 horse-power to the New Castle (Pa.) Electric Company, and some additional ones to the Phoenix Iron Company, Phoenixville, Pa.

ADAMS-BAGNALL LAMPS IN COCHIN-CHINA.—The Adams-Bagnall Company, Cleveland, Ohio, recently made a shipment of a number of arc lights to Cochin-China.

THE RIKER ELECTRIC VEHICLE COMPANY has sold its business to and been succeeded by the Riker Motor Vehicle Company.

General News.

THE TELEPHONE.

WAUSAU, WIS.—The Wausau Telephone Company's list of subscribers has reached the 400-mark.

MILWAUKEE, WIS.—The linemen of the Wisconsin Bell Telephone Company have asked for an increase of wages.

ST. LOUIS, MO.—The St. Louis board of equalization has assessed the Kinloch Telephone Company $443,680 on its personal property.

RICHLAND CENTER, WIS.—The Badger Telephone Company has been granted permission by the council to enter the city and erect an exchange.

SCRANTON, PA.—Among the charters recently issued at Harrisburg was one to the Anthracite Telephone Company, of Jermyn. The capital is $20,000.

YORK, PA.—The Columbia Telephone Company is putting up an additional trunk line across the Susquehanna River to connect with York County.

ALAMEDA, CAL.—The town trustees of Alameda, Cal., have taken steps toward imposing a tax of 25 cents annually upon each telephone in use in the city.

BLOOMDALE, OHIO.—The Federal Telephone Company, of Cleveland, is putting in a local exchange to compete with the Central Union Telephone Company.

SAULT STE. MARIE, MICH.—The Michigan Telephone Company has completed its new circuits from Grand Rapids to Petoskey and intermediate stations.

RICHMOND, VA.—The Virginia Association of Independent Telephone companies was organized at Richmond. The companies banded together for mutual protection.

DETROIT, MICH.—The Hotel Cadillac has made a contract with the Michigan Telephone Company for 200 long distance telephones, to be placed in every room.

MILWAUKEE, WIS.—This city will soon have telephone connection with northern Michigan cities. A line is in progress of construction between here and Marinette.

LOST VALLEY, ORE.—The Lost Valley Telephone Company, of Lost Valley, has been incorporated. Capital, $8000. Incorporators: A. Hardie, C. W. White, J. Trizzed.

YORK, PA.—The Lancaster, Columbia and York independent telephone companies have reached an agreement by which Lancastrians are now able to talk through to York and Lebanon.

WILMINGTON, DEL.—The Chester County (Pa.) Telephone Company is to enlarge its field of operations at once and the work will be commenced as soon as the weather will permit.

PORTAGE, WIS.—The Wisconsin Telephone Company intends to construct a line from Randolph to Portage this summer. Another line will be built to Baraboo by the way of Kilbourn.

COMMERCE, TEX.—The Commerce Telephone Company has been incorporated. Capital, $5,000. Incorporators: W. B. De Jarnett, T. W. Thompson, G. W. Apperson, all of Commerce.

WAVERLY, VA.—The Waverly Telephone & Telegraph Company has been incorporated. Capital, $500,000. Incorporators: P. Rogers, P. Fleetwood, R. D. Owen, C. D. West, C. H. Davis, all of Waverly.

THE ALLEGANY MUTUAL TELEPHONE COMPANY has been incorporated at Albany, N. Y. Capital, $25,000. Directors: Ezra Hamilton, Orson W. Robinson, J. R. Willard and others, of Allegany County.

CAMDEN, N. J.—The Keystone Telephone Company, of Camden, has been incorporated. Capital, $2,000,000. Incorporators: N. Grey, S. S. Izard, both of Woodbury; W. H. Chew, of Camden; N. Grey, attorney, Camden.

FREEPORT, L. I.—The South Shore Telephone Company has completed the work of installing its experimental line. Nearly 100 telephones have been put in on three months' free trial to test the new central energy system.

POINT PLEASANT, N. J.—The Seashore Telephone Company has been incorporated. Capital, $2000. Incorporators: C. W. Dampman, H. Johnson, J. W. Johnson, all of Point Pleasant; Parker & Pearce, attorneys, Manasquan.

HARRISBURG, PA.—The Valley Telephone Company, Emlenton, Pa., has been incorporated. Capital, $5000. Incorporators: H. J. Crawford, T. B. Gregory, O. H. Mahood, J. Grieff, J. J. Gosser, S. P. Barnard, all of Emlenton.

AUSTIN, TEXAS.—Mr. C. N. Haskell, of Ottawa, Ohio, president of the Lone Star Telegraph & Telephone Company, which was recently chartered here, states that the company proposes to expend not less than $1,000,000 in Texas.

BAY CITY, MICH.—The West Bay City Exchange, of the Michigan Telephone Company, was damaged by fire recently, caused by the crossing of an electric light wire with a telephone wire. The loss, it is stated, was about $1000.

CHARLESTON, W. VA.—The Charleston & Sisterville Telephone Company has been incorporated. Capital, $1200. Incorporators, P. Silman, E. M. Keatley, W. Morgan, J. H. Thompson, A. J. Spaulding, P. S. Shirkey, all of Charleston.

SCRANTON, PA.—The Tunkhannock Telephone Company, under the management of A. P. Bedford, of Scranton, is seeking to improve its service and to that end has purchased a new switch board and other fittings for an exchange.

GREENSPRING, OHIO.—The Greenspring Telephone Company has been incorporated. Capital, $8,000. Incorporators: J. C. Kenney, E. L. Johnson, P. T. Perin, R. D. Reynolds, H. W. Robinson, E. E. Meikirk, R. V. Johnson, C. L. Smith.

LISBON, OHIO.—The Columbiana County Telephone Company has opened its new exchange at this place. About 150 lines have been connected. A handsome suite of rooms has been fitted up for the night operators, who will sleep in the exchange.

ALBANY, N. Y.—A copy of the proceedings for the voluntary dissolution of the Standard Telegraph & Telephone Company have been filed with the Secretary of State. The company's principal office was in Lowell, Mass., with branch offices in this State.

PENNINGTON, VA.—The Pennington Gap Telephone Company has been incorporated. Capital, $5000. Incorporators: W. H. Nickels, J. C. Parish, J. N. Duff, H. L. Anderson, B. T. Young, C. V. Young, G. C. Duff, A. J. Latton, J. M. Flanery, all of Lee County.

SNICKERSVILLE, VA.—The Snickersville Telephone Company has been incorporated. Capital, $5000. Incorporators: E. Hawling, C. B. Turner, C. H. Osborn, A. J. Simpson, J. A. Lynch, J. B. Thomas, G. E. Plaster, Jr., H. G. Plaster, A. C. Bell, all of Snickersville.

MINNEAPOLIS, MINN.—The Northwestern Telephone Company, according to a recent decision handed down by Judge McGee, is doing business in Minneapolis not under a contract, but under a mere license or permit. The company will probably carry the case to higher courts.

GOLDENDALE, WASH.—The long-distance telephone lines are being constructed from Goldendale, Wash., to Blockhouse and Camas Prairie. It is reported that a telephone line will be extended across the Simcoe mountains and through the Indian reservation to North Yakima.

BILOXI, MISS.—The board of aldermen have received a petition from the Cumberland Telephone Company for a franchise from the city. The company proposes to charge from $1 to $2.50 per month for resident instruments, and from $2 to $3.50 per month for business instruments.

HARRISBURG, PA.—The Harrisburg Telegraph & Telephone Company has applied for a charter. It is understood that this company will co-operate with the Southern Pennsylvania Company, which has franchises through the Cumberland Valley and other southern sections of the state.

OTTAWA, ONT.—The changes in the local telephone system of Ottawa, Ont., which have been in course of preparation for about a year, are sufficiently advanced to be put into use. When the new instruments are installed, Ottawa will have the very latest thing in the way of a telephone equipment.

MANHATTAN, MONT.—The West Gallatin Irrigation Company is considering the subject of erecting a telephone line along its irrigation canal in order to enable ditch riders to telephone to headquarters in the case of a break or other trouble. E. C. Kinney, general manager, may be addressed.

OSHKOSH, WIS.—The Little Wolf Telephone Company, an independent concern, will be granted a franchise at the next meeting of the council. The Wisconsin Company just paid $40,000 to get rid of one company—the Oshkosh Northwestern,—which had been in operation here about four years.

BIRMINGHAM, ALA.—A new telephone company has petitioned for a charter for the installation of a new system here and offers to make its rates one-half of those charged by the Southern Bell Company. The Bell Company is fighting against the granting of the franchise to the home company.

UTICA, N. Y.—The Black River Telephone Company has established exchanges and toll stations at Boonville, Port Leyden, Lyons Falls, Greig, Glenfield, Watson, Beaches Bridge, Lowville, Turin, Houseville, Constableville, Mohawk Hill, West Leyden, Ava, West Branch, Delta, Lee Center and Rome.

DETROIT, MICH.—The longest submarine telephone cable in the United States was put in operation and tested on April 19 by the Michigan Telephone Company. The cable is laid across the Straits of Mackinac. Conversation was carried on between the Marquette and Detroit offices and with Pittsburg and other stations East.

DENVER, COLO.—It is announced that representatives of a proposed new independent telephone company are looking over the field in the western part of the state, with a view to introducing a new system. If the enterprise is decided upon, the line will start at Rifle and extend to Meeker, Craig and other small places in the Hahn's Peak country.

NEW HAVEN, CONN.—Ex-Governor Waller, counsel for the local telephone company, for which Judge Thayer found there was no public necessity, will cause further litigation, in the United States court, in the interests of some of the outside stockholders. Backers of the Boston company that wanted to get into Connecticut will help in this fight.

MINNEAPOLIS, MINN.—The Mississippi Valley Telephone Company is having trouble with its construction employees. A few days ago the 40 men struck because their checks were not forthcoming on pay day. After a couple days lay off they were paid in full; then they demanded remuneration for the time spent in securing their pay. The matter has finally been adjusted.

WASHINGTON, D. C.—At a meeting of the recent purchasers of the Home Telephone Company a reorganization was effected under the name of the Capital City Telephone Company. The following officers were elected for the ensuing year: Julian Taylor, president; Anthony W. Armstrong, vice-president; Titian W. Johnson, of Washington, secretary and treasurer, and Francis F. Marbury, manager.

RICHMOND, VA.—A long distance telephone company of Virginia has been organized in this city, and steps will be taken at once to procure a charter. The following named gentlemen have been appointed a committee to formulate plans, etc.: Messrs. F. W. Sims, B. Laughan, N. C. Watts, S. L. Hoover, Walter Switzer, C. W. Scott, W. J. Nelms, C. R. McCluer, James R. Kemper, J. E. Wood, C. M. Gilliam.

BOSTON, MASS.—The Massachusetts Telephone & Telegraph Company is pushing along with its long distance metallic circuits running out from Boston to Providence and elsewhere, is also connecting up the subscribers for its new service in Boston and suburbs. Plans have also been prepared for a new central exchange in Boston and work on the building will now be pushed. Concurrently with all this active progress and developing the company is busily engaged in making application for charters that will enable it to do business in all the neighboring towns and cities.

WASHINGTON, IND.—The capital stock of the Hoosier Telephone Company of this city and county, has been increased from $10,000 to $50,000.

PENDLETON, IND.—The Pendleton Telephone Company, recently incorporated, is going ahead with the construction of a plant. E. D. Allen is the leading spirit. The line will be in operation by May 1.

INDIANAPOLIS, IND.—The Brownstown Telephone Company has been incorporated. The capital stock is $15,000. The Hartville Rural Telephone Company has also been incorporated, with no capital stock named.

DENVER, COLO.—An extension of the line of the Colorado Telephone Company from Glenwood Springs, the present terminus, to Grand Junction, a distance of 90 miles, is contemplated. It is probable that work will be begun as soon as the weather becomes settled.

GOSPORT, IND.—The country hereabouts is fast becoming a network of telephone lines. A number of independent lines have been built, more are building and still more projected. The Farmers' Mutual is the strongest and most extensive system, having a large number of farmer and also business patrons. The Bell Company is making strenuous efforts to capture the independent lines, but so far without success.

INDIANAPOLIS, IND.—The Central Union Telephone Company has decided to make a number of changes beginning May 1. There will be two divisions of the company's system—one in northern and one in southern Indiana. The headquarters for the former will be at South Bend, and Indianapolis will be the headquarters for the southern division. W. G. Worth will be promoted to the position of superintendent of the southern division, and Mr. Vail will become general superintendent, with business office probably in Chicago. The great increase in the company's business has made this move necessary.

ELECTRIC LIGHT AND POWER.

SCRANTON, PA.—The Susquehanna Electric Light, Heat & Power Company is stringing wires for its new lighting system.

PHILADELPHIA, PA.—The Scranton Electric Light & Heat Company has been absorbed by the Electric Company of America.

LANSING, MICH.—The Peninsula Electric Light & Power Company, of Houghton, Mich., has increased its capital stock $50,000.

GREENTOWN, IND.—The electric light plant in this place, together with all of its contents, was entirely destroyed by fire on April 6. The plant was owned by the city.

SELKIRK, MAN.—The Selkirk Electric Company, of Selkirk, Man., has asked the Manitoba government for a charter to build an electric railway between Selkirk and Winnipeg.

NEW HAVEN, CONN.—The Connecticut Light & Power Company, controlled by A. M. Young, has made an offer of $55,000 for the South Norwalk Municipal Electric Light Company.

BELVEDERE, ILL.—The Belvedere Light, Heat & Power Company has changed its name to Belvedere Gas & Electric Company, and has also increased its capital stock from $125,000 to $150,000.

NORWALK, OHIO.—The Northern Gas & Electric Light Company of this place, owned by Hon. Parks Foster, of Elyria, has been sold to C. H. Stewart, of Cleveland, and W. G. Price, of Norwalk.

BILLERICA, MASS.—Voters here have referred to a committee a proposition to have the town lighted by electricity. They rejected a plan to have a telephone plant under direction of town officials.

DENVER, COLO.—The fire and police boards of Denver expect to introduce the Gamewell storage battery system, which will, it is thought, effect a substantial saving in the operation of the fire alarm plant.

OTTAWA, ONT.—The Nova Scotia Electric Light Company has had a second survey made of the proposed water power electrical development in the Annapolis valley. It is understood that complete plans will be prepared at once.

KENSETT, IOWA.—The Kensett Mill & Light Company, Kensett, has been incorporated. Capital, $10,000. Incorporators: N. E. Thoen, C. Locke, J. Burgeson, H. A. Biorgo, H. A. Gullickson, B. P. Bolkan, H. E. Gray, all of Kensett.

LIMA, PERU.—Another illustration of improving conditions in Peru was furnished recently when the public subscribed one million sols of capital stock for the Santa Rosa Electric Light Company, which has a concession for lighting Lima.

PORT WASHINGTON, N. Y.—The Port Washington Electric Light, Heat & Power Company, capital $7500, has been incorporated. Directors: Charles F. Lewis, L. B. Smull, J. O'Brien, John J. McDermott and John H. Burtis, of Port Washington.

LOS ANGELES, CAL.—The United Electric Gas & Power Co., Los Angeles, has been chartered. Capital, $650,000. Incorporators: H. V. Carter, G. I. Cochran, both of Los Angeles; F. H. Rindge, J. J. Davis, both of Santa Monica; A. Stedman, of Monrovia.

MANCHESTER, VA.—The Manchester Light, Heat & Power Company, Manchester, has been chartered. Capital, $50,000. Incorporators: A. L. Anderson, of Bon Air; G. E. Gary, A. J. Daffron, W. P. Mathews, A. Royall, E. H. Wells, C. Vadon, all of Manchester.

ALLEGHENY, PA.—A number of the council men of the city of Allegheny have decided that the city electric lighting plant shall sell its current to private consumers the same as any ordinary commercial electric plant. If this is done the plant will have to be considerably enlarged.

ALBANY, N. Y.—A certificate of merger of the Bergen Beach Light & Power Company by the Edison Electric Light Illuminating Company, of Brooklyn, has been filed with the secretary of state. The capital stock of the Bergen Beach Company, $25,000, is owned entirely by the Edison Company.

ST. LOUIS, MO.—The City Lighting Company filed a deed of trust on April 17 on a lot fronting on Neouna Street and other property, in favor of the Northern Trust Company, trustee for the bondholders. The instrument is intended to secure the payment of bonds amounting to $600,000, due in ten years at 5 per cent. interest.

NATCHEZ, MISS.—Attorney General McClurg has rendered an opinion to the city of Natchez that lighting companies furnishing gas and electricity under one charter must pay a privilege tax as an electric light and also as a gas concern. In other words, no company can furnish the two classes of lights under one privilege tax.

DELAWARE, OHIO.—The Delaware Electric Light & Power Company has changed its name to the Delaware Electric Light, Power & Heating Company and its capital stock has been increased from $75,000 to $100,000. The company proposes to utilize the waste steam and heat from its engines and boilers and convey it throughout the city for heating purposes.

HAMMOND, IND.—The plant and business of the Lake Lighting Company which was recently bonded for $100,000, has been sold to a company of local capitalists. The officers of the company are: W. H. Gostlin, president; A. J. Campbell, treasurer and manager; E. P. Ames, secretary. The company's contract for municipal lighting runs for a period of seven years.

NEW LONDON, WIS.—A plan is on foot for the development and use of the water power of the Little Wolf for purposes of electric lighting and manufacturing in New London, Berlin and Oshkosh. Also to furnish power for the Berlin-Oshkosh electric railway to be built this year. Two hundred thousand dollars are said to be required for the full development of the scheme.

DENVER, COLO.—The city government has granted a new electric light franchise to Mr. Chas. F. Lacomb. This will have a serious effect on the Denver Consolidated Gas & Electric Company, and promises relief to the citizens by reduction of 50 per cent. in rates for the private consumption of electricity, besides a very considerable reduction to the city and large public consumers of light.

SAYVILLE, L. I.—It is proposed to organize an electric light plant in this place, with a capital stock of $15,000. It will be named "The Sayville Electric Light, Heat & Power Company." Among those interested are: Daniel D. White, Mr. G. A. Robinson, Charles N. Aldrich, Julius Hauser, William F. Le Cluse, Francis Garber, Joseph A. Nauert, Sewell Thornhill and I. H. Green, Jr.

WEST COVINGTON, KY.—The city council of West Covington is seriously considering the abandonment of electricity for illumination. As a substitute they will use coal oil lamps. This rather out-of-date proceeding was brought about by the many complaints that were made of the poor electric light service. It is actually said that a number of the councilmen are in favor of the backward change.

CANON CITY, COLO.—The Colorado Electric Power Company has been granted a franchise for electric lighting and power in Canon City, Colo. This is the company which operates the power plant in Canon City for transmitting electric power for the mines in the Cripple Creek district. The company will expend about $25,000 on the lighting plant. D. V. Donaldson, of Colorado Springs, is at the head of the company.

DENVER, COLO.—The Lacombe Electric Company, which was recently granted in Denver a franchise for municipal and commercial light and power, contemplates the erection of a power station at Marshall. This town is about 25 miles north and west of Denver, in the heart of the coal district. This plant would be used for commercial lighting and power, and its erection would not preclude the construction of a plant in the city.

ASHLAND, N. H.—The Ashland Electric Light Company has completed its new station. The main building is 32 by 35 feet, and the boiler house adjoining is 17 by 30 feet. In this is placed a 1000-hp boiler, thus enabling the company to use steam whenever the conditions of low water make it necessary. The dam has been almost entirely built over with solid granite and cement. The new plant cost the company between $7000 and $8000, and will greatly increase the service capacity.

ST. LOUIS, MO.—The board of equalization, April 13, summoned before it the various lighting companies, with a view of increasing the assessments against each. Those heard were President S. M. Dodd and W. B. Thompson, of the Missouri-Edison; Manager Ross, of the Laclede Gas Light Company: Manager Nablack, of the Laclede Power Company, and Aug. Gehner, of the Citizens'. It is claimed that considerable revenue is lost by the bonds and stock of those companies being undervalued.

DURANGO, COLO.—The preliminaries have been completed for the organization of an electric light and power company at Durango, Colo. The plant will be located on the Animas River, near Rookwood, twenty miles above Durango. The company will supply with light and power the mines of La Plate, San Juan, Dolores and Montezuma counties. R. J. McCartney, of Durango, is one of the chief promoters of the enterprise. The plant will greatly stimulate mining in southwest Colorado.

MT. VERNON, ILL.—The City Council and the electric light company are in a quarrel over a renewal of the lighting contract. The council refuses to ratify the recent agreement for a six-year contract unless the company recedes from its refusal to allow the city to string its fire alarm wires on the poles owned by the company. The company will not consent to this unless protected by the city with an indemnifying bond, and threatens to cut off the city circuit unless the contract is at once ratified.

BOSTON, MASS.—The Hoosac Tunnel Docks, located on the Charlestown side of Boston harbor, have just been equipped with an electric hoisting system which makes it possible to load and unload freight on ocean-going steamers at a rate and with an ease that cannot be approached at any other seaport. A peculiar feature of the apparatus is that it works most economically when fully loaded. When fully loaded the machine runs on 10-hp; when only partly loaded, it requires 25-hp, the power being furnished by electric motors. There are nine of these hoists in the sheds, and they are said to be the only ones in existence.

THE ELECTRIC RAILWAY.

ALBANY, N. Y.—The United Traction Company, of this city, has declared a quarterly dividend of 1¼ per cent., payable May 1.

DETROIT, MICH.—The Detroit & Toledo Electric Railway Company will build a depot machine shop and power house at Monroe.

VENICE, ILL.—The new power house of the Brooklyn Construction Company's electric railway to East St. Louis is being constructed here.

DETROIT, MICH.—The Grand Rapids, Grand Haven & Muskegon Electric Railway Company has decided to build power houses at Spring Lake and Lamont.

ST. PAUL, MINN.—The Twin City Rapid Transit Company has sold 3000 shares of preferred stock from the treasury to retire 6 per cent. debenture bonds due May 1.

CLEVELAND, OHIO.—The Cleveland City Railway Company has placed a contract for a 800-kw Westinghouse generator to be direct connected to a Globe Iron Works engine.

PROVIDENCE, R. I.—The new trolley road between Providence and Warren will be completed this season, and the extensions to Bristol and Fall River are almost sure to follow.

LAPORTE, IND.—The commissioners of Laporte County have granted a franchise to the Northern Traction Company to build an electric line between Laporte and Michigan City.

PERU, IND.—Capitalists of this city, headed by C. H. Brownell and R. A. Edwards, have organized a company for the purpose of constructing an electric railway from Peru to Converse.

HOUGHTON, MICH.—The capitalization of the Houghton County Street Railway Company is $750,000. Orders for material have been placed and construction will begin next month.

APPLETON, WIS.—It is now probable that the Interurban line from Appleton to Kaukauna will not be built for another year. The company is said to be not satisfied with the franchise recently granted.

PORTLAND, ORE.—The Portland Traction Company has been granted an electric street railway franchise here. The company has agreed to exchange transfers with the Portland Street Railway Company.

RAHWAY, N. J.—Work has been commenced by the Riker trolley syndicate on the cross-country electric railway that is to run between Rahway, N. J., and Springfield, crossing the Plainfield-Elizabeth line at Westfield.

MILWAUKEE, WIS.—The Milwaukee Electric Railway & Light Company is negotiating for the purchase of 50 new street cars, at a cost of $5000 each. These will all be large double truck cars, as the company is displacing its single truck cars gradually.

ALLEGHENY, PA.—The council of Allegheny City has granted franchises for the construction of electric railways to the Nunnery Hill Electric Railroad Company and to the Evergreen Electric Railway Company. The roads will be built immediately.

MARLBORO, MASS.—The Marlboro street railway, which consists of the Marlboro & Hudson and the Framingham, Southboro & Marlboro street railways, has been sold to James F. Shaw & Co., who have had an option on the road for several months.

BOSTON, MASS.—The Massachusetts Electric Companies have petitioned the selectmen of Dedham for the West Roxbury & Roslindale Street Railway Company for the right to make changes in location so as to enable them to connect all the roads of their system.

NASHVILLE, TENN.—The People's Railroad Company, of Nashville, has been incorporated to construct and operate a street railway. Capital, $100,000. Incorporators: D. H. Bailey, J. L. Whitworth, C. F. Sharp, P. S. Breen, E. Jones, J. H. Eakin, all of Nashville.

IRWIN, PA.—The Greensburg, Jeannette & Pittsburg Traction line will be sold under foreclosure of a $500,000 mortgage at Greensburg on May 1. The sale includes all the personal property, franchise and real estate, including Oakford Park, a summer resort near Jeannette.

DAYTON, OHIO.—Judge Dennis Dyer of this place is at the head of a project for an electric road through Miami County, through what is known as the Stillwater Valley. It is proposed to connect the towns of Covington, Pleasant Hill and West Milton with Dayton.

BOWLING GREEN, OHIO.—The Toledo, Bowling Green & Fremont Electric Railway has about completed its new car barns and headquarters at this place. One of the features of the building will be a finely equipped reading room for the use of employees when off duty.

NEW ORLEANS, LA.—The Orleans Street Railway has declared a dividend of 1 per cent., payable April 16. The last dividend paid by the road was in June, 1894, when a 1½ per cent. quarterly dividend was declared. Business is much better with the road now, and it is also in good physical condition.

HARRISBURG, PA.—The Carnegie & Rosslyn Park Passenger Street Railway Company, Carnegie, has been incorporated. Capital, $7500. Incorporators: F. Armstrong, of Pittsburg; F. P. Iams, of Sheridan; M. Lemon, of Knoxville; W. J. Sheridan, of Sheridan; W. H. Roberts, of Carnegie.

YOUNGSTOWN, OHIO.—The Mahoning Valley Railway Company is making extensive improvements to its power house at this place. A new engine, boilers and generators are being installed and a large force is at work rebuilding the tracks. The road is being extended on Mill Street.

OAKLAND, CAL.—The Oakland Transit Company's Piedmont power station now has ample capacity for operating all of the electric lines in Oakland, Cal. The new 800-kw Bullock generator, which was recently installed by the Wybro-Hendy Company as agents for the manufacturers, has given perfect satisfaction.

CLEVELAND, OHIO.—The firm of Carpenter & Myers, who are at the head of a project to build an electric road from Lima to Cridersville, state that the right of way has been almost entirely secured with the exception of a short strip between Lima and Cridersville.

DELAWARE, OHIO.—The Delaware County board of commissioners has granted to Sullivan & Simmons, of Columbus, the right of franchise to construct an electric road on Delaware County territory. The line will connect Delaware and Columbus and the construction must start July 1 next and the road be completed one year later.

DENVER, COLO.—Warren C. Dyer has been appointed receiver of the Boulder Railway & Utility Company, which controls the railway running from the Boulder Depot to the Chautauqua grounds. It is probable that the receiver will ask the court to grant him permission to borrow from $6000 to $10,000 for the purpose of extending the line.

WABASH, IND.—The Ohio & Indiana Traction Company, which secured rights of way through this and adjoining counties for an electric line from Hicksville, Ohio, to Marion, has abandoned the project. The city of Fort Wayne imposed such terms that the company could not hope to build a profitable business without touching Fort Wayne, hence the abandonment.

WATERLOO, N. Y.—The project for building an electric road from Syracuse to Skaneateles and thence to Auburn and Cayuga Lake, with the ultimate purpose of connecting with the Geneva, Waterloo, Seneca Falls & Cayuga Lake Traction Company, has been revived. The road from Syracuse to Skaneateles seems to be a fixed fact, a part of the bed having already been graded.

BOSTON, MASS.—The Chelsea & Revere Street Railway Company has petitioned for incorporation, with a capital stock of $180,000. The following named gentlemen constitute the board of directors: George H. Carter, of Chelsea, Mass.; Joseph R. Carr, of Chelsea, Mass.; E. G. Tutein, of Revere, Mass.; George T. Wilson, of Revere, Mass.; Otis G. Burnap, of Boston, Mass.; George S. Forbush, of Brookline, Mass.

CHICAGO, ILL.—The board of trustees of the town of Cicero have again adopted an ordinance granting the Aurora, Wheaton & Chicago Railway Company a 50-year franchise. The promoters of the new road were forced to accept the amendment of offering and keeping for sale commutation tickets of eight rides for 25 cents, good for any point from the western boundary of Cicero to any station of the road in Chicago.

LANSING, MICH.—John T. Mills, of Port Huron, and Chicago capitalists have become interested in the proposed Lansing & Ithaca electric railway. They propose to invest $300,000 for the construction of the road on condition that $100,000 in stock is taken by the people of Lansing and towns along the line. Railroad meetings will be held and an effort made to secure subscriptions for the stock. The road will cost about $1,300,000.

PITTSBURG, PA.—Several changes were made in the operating department of the Consolidated Traction Company. W. H. Schoep has been made general manager. He was formerly connected with the traction roads in Washington. Mr. Charles Fitzgerald will still retain his position as general superintendent of the road. The position Mr. Schoep takes is the one made vacant by the resignation of G. F. Greenwood nearly a year ago.

WORCESTER, MASS.—The Worcester, Rochdale & Charlton Street Railway Company has petitioned for incorporation. The capital stock of the company is $100,000. The proposed road will run from Charlton to Leicester. Among the incorporators are: Malcolm G. Clark, Leicester, Mass.; Frederick A. Blake, Leicester, Mass.; William N. Howard, Easton, Mass.; Charles E. Barnes, Malden, Mass., and Fred T. Ley, Springfield, Mass.

NEW HAVEN, CONN.—The New England Street Railway Company has sold a controlling interest in the Winchester Avenue Street Railway Company, of New Haven, to I. A. Kelsey, representing the Bridgeport traction syndicate. It is claimed that Mr. Kelsey purchases a controlling interest at $48 per share and minority stockholders may secure an injunction to prevent the transfer, claiming the stock was worth more than this price.

ST. LOUIS, MO.—President J. B. C. Lucas, of the Wellston, Creve Coeur Lake & St. Charles Railway Company, wants a franchise from the St. Louis county court to construct an extension from Carsonville, along the National Bridge road to the western part of the county. The company promises to pay into the county treasury $1000 on the day the work begins, $200 ten years afterward, and $200 each year during the life of the franchise.

EAST ST. LOUIS, ILL.—Work began on the Mississippi Transit Company's road April 9. The road will run from East St. Louis to Edwardsville, Ill., by the way of Collinsville. Contracts have all been signed, the money provided, the franchise secured, and the right of way purchased. The franchise is good for fifty years, and includes the right to haul freight and coal. C. F. Blanke is president, J. F. Conrad secretary and treasurer, and Henry Gauss vice-president.

CLEVELAND, OHIO.—The Cleveland Electric Railway Company is now receiving the first of a lot of 50 double truck open cars from the St. Louis Car Company. The company has also ordered forward a lot of 50 closed cars from the J. G. Brill Company, the last of a lot purchased last year. The equipment for these cars consists of two 35-hp, type 49 Westinghouse motors, and they are the windup of a contract for 250 sets placed last summer with the Westinghouse Electric & Manufacturing Company.

ST. LOUIS, MO.—Among the officials who have resigned from the St. Louis Transit Company's employ within the past few days are Joseph S. Minary, superintendent of the northern division; John I. Pearson, chief engineer; F. I. Drake, master mechanic, and Thomas J. Murphy, chief claim agent. With the exception of Mr. Murphy, these gentlemen have already severed their connections with the company. Mr. Murphy's resignation goes into effect May 1. That of Mr. Minary took effect April 15.

NEW HAVEN, CONN.—The United Gas Improvement Company, of Philadelphia and New York, which recently absorbed the Bridgeport Traction Company, will take over the property of the Derby Street Railway Company, capitalized at $150,000, within a week or two. The syndicate will apply to the legislature at its next session for a franchise to extend the road to Seymour, four miles up the Naugatuck River. The purchase will give the syndicate control of all the trolley lines from Stamford to Derby, a distance of 80 miles.

COLUMUS, OHIO.—The Urbana, Mechanicsburg & Columbus Railroad Company was incorporated at Columbus, Ohio, on April 17. The capital stock is $100,000. The company is to operate an electric line from Urbana to Columbus and will carry freight and mail besides passengers. The company will arrange to furnish electric light service also. All the incorporators save one, General Axline, are business men of Urbana or Mechanicsburg.

CAIRO, EGYPT.—The name of the company operating the tramways in Cairo is the "Societe Anonyme des Tramways de Cairo." Mr. Fernand Mignot is the secretary. The company is a Belgian concern.

THE AUTOMOBILE.

RENTER AUTOMOBILE COMPANY, of Chicago, has been incorporated, with a capital stock of $500,000, for the purpose of manufacturing motor vehicles.

THE EMPIRE STATE AUTOMOBILE COMPANY, of Rochester, N. Y., has been incorporated. Capital, $20,000. Directors: Martin F. Pinkney, George E. McElroy, Albert L. Cole and Herbert Clarke, Rochester.

JERSEY CITY, N. J.—The Engelmann Patent Vehicle Gear Company, Jersey City, has been incorporated to deal in vehicles. Capital, $100,000. Incorporators: E. Engelmann, J. H. Vollers, J. Sullivan, all of Jersey City; W. Grece, attorney, Jersey City.

CHARLESTON, W. VA.—The Eastman Automobile Company, Cleveland, Ohio, has been incorporated here to manufacture and deal in automobiles. Capital, $100,000. Incorporators: M. M. Hobart, H. F. Eastman, L. C. McLouth, J. H. Lee, N. E. Bixler, all of Cleveland, Ohio.

NEW JERSEY AUTOMOBILE LIVERY COMPANY, Newark, N. J., has been incorporated to deal in automobiles. Capital, $100,000. Incorporators: F. W. Butler, J. B. Morris, both of Newark; E. D. Harrington, of East Orange; E. W. Keese, of Flatbush; F. G. Smith, of Brooklyn.

CLAPP MOTOR CARRIAGE COMPANY, of Jersey City, has been incorporated, with a capital stock of $600,000, for the purpose of manufacturing automobiles. The incorporators are: S. H. Wagner, R. K. Waller, C. N. King, D. C. Ferris, P. E. Dudley, all of Jersey City, and C. N. King, attorney, Jersey City.

THE GENERAL CARRIAGE COMPANY has leased the Sixth Avenue car station, located in Sixth Avenue, between Forty-third and Forty-fourth streets, New York. The company will take immediate possession. Fifty new broughams and cabs have been received by the company, and are to be placed in service at once.

THE OXFORD AUTOMOBILE COMPANY, of Augusta, Me., has been incorporated, with a capital stock of $600,000, for the purpose of manufacturing automobiles. The incorporators are: F. Melone, G. F. Killane, both of Everett; H. F. Stevens, of Marlboro; C. W. Jones, C. M. Randall, both of Augusta, and C. W. Jones, of Augusta.

AUTOMOBILE FACTORY IN MINNEAPOLIS.—The local stock company formed here last January for the purpose of the manufacture of automobiles, has begun the construction of a new type of electric vehicle, which is said to possess many advantages. The company begins business with a capital of $800,000, divided into 800 shares of $100 each.

THE UNITED STATES MOTOR VEHICLE COMPANY.—Two attachments have been filed against the United States Motor Vehicle Company, 1123 Broadway, New York, aggregating $542, on the ground that it is a New Jersey corporation. Another attachment was taken out against the company for $679, in favor of the United States Projectile Company.

THE AUTOMOBILE PATENTS' EXPLOITATION COMPANY has been incorporated at Trenton, N. J. The company will have an authorized capital stock of $1,000,000, divided into $250,000 7 per cent. preferred stock and $750,000 common stock. The object of the company is the buying, selling, exploiting financing, marketing, etc., letters patents, etc., concerning automobiles. The incorporators were H. A. Wise Wood, Thomas Russell, Thomas C. Clarke, O. C Barber and Samuel P. Colt.

THE BALTIMORE AUTOMOBILE & MANUFACTURING COMPANY has recently been awarded a contract by the American Autocarette Company, of Washington, for the construction of 10 electrical omnibusses for service in Washington. The vehicles will have a speed of 12 miles an hour, the maximum speed permitted on the streets of Washington. They will have two motors of 4 horse power each and will accommodate 20 passengers without crowding. The amount of the contract price for the vehicles is said to be in the neighborhood of $40,000

A NEW AUTOMOBILE COMPANY has been organized in Indianapolis, Ind., and the Old Boot & Shoe factory on Brookside Avenue will be remodeled into a first class plant. Several styles of automobile vehicles are to be manufactured, and the necessary machinery is expected from the east in a short time. The chief promoter of the enterprise is William Butler, o. Red Key, Ind. A number of prominent business men are interested in the company. The conduct and management of the business will be under the charge of O. M. Fowler, of this city. This will make four automobile factories for Indianapolis.

SIPE & SIGLER, Cleveland, Ohio, have completed an electric vehicle of the Stanhope pattern, which they will utilize in demonstrating the practicability of their storage batteries for motor vehicle purposes. The carriage weighs 1440 pounds, including the battery, 625 pounds. Repeated tests have shown it capable of traveling over 40 miles on one charge, over all kinds of roads. It is equipped with a 2-hp Elwell-Parker Company's motor and it has three forward speeds-3, 5½ and 12 miles per hour. The vehicle was designed and constructed by Mr Willard, inventor of the Willard battery, and it is of such attractive design that a number of local enthusiasts are organizing a company for the purpose of manufacturing carriages after the design and details of construction of the vehicle mentioned. Messrs. Sipe & Sigler, however, will have no connection with the new company, as they expect to continue giving their entire attention to the manufacture of batteries.

NEW INDUSTRIAL COMPANIES.

ANDERSON, S. C.—The Anderson Water, Light & Power Company has asked for a franchise from the city authorities to build an electric street railroad.

THE KEYSTONE ELECTRIC COMPANY, of Philadelphia, has been incorporated, to engage in manufacturing, engineering and construction. Capital $200,000.

THE B. B. ELECTRIC COMPANY, of New York City, has been incorporated Capital, $30,000. Directors: J. T. Beswick and David Beswick, Brooklyn; E. Nicholson, New York City.

THE ROBERTS BATTERY COMPANY, of New York, has been incorporated, with a capital of $20,000. Directors: Edmund Tweedy and Isaiah L. Roberts, New York City; George R. Tweedy, Danbury, Conn.

CHARLESTON, W. VA.—The Charleston Electrical Supply Company has been incorporated by Edwin Polsue, E. C. Marwin, E. C. Polsue and others to conduct general electrical supply and repair business. The authorized capital is $50,000.

NORFOLK, VA.—The Electrical Construction Company has been incorporated to conduct a general construction business, with Powell Evans, president; A. H. Engstrom, vice-president; Mangus Hellstrom, secretary and treasurer, all of Philadelphia, Pa. Capital stock, $2000, which may be increased to $40,000.

KANSAS CITY, MO.—Articles of incorporation of the Kansas City Telephone Manufacturing Company have been filed. The capital stock is $5000. The incorporators are: Edward L. Foutch, F. M. Bernardin, E. B. Royer. The company is to manufacture and deal in telephones and other electrical appliances and to install and operate telephones.

LEGAL.

THE THERMO-ELECTRIC COMPANY.—An application has been made for the voluntary dissolution of the Thermo-Electric Company, and Justice Fitzgerald, of the Supreme Court, has appointed Louis Wendel referee to inquire into the merits of the application. It was stated that the company ceased to do business September last and has no assets, and the only liability is a claim of the city and county of New York for $4920 personal taxes.

OBITUARY.

SALVATOR POTIS, chief engineer of the Illinois Telegraph & Telephone Company, was found dead in a room at the Technical Club, in Chicago, on April 18, with a pistol-shot wound in the heart. It is believed that he took his life while temporarily insane from the effects of an attack of grip. He was the designer of some of the largest power houses in Chicago.

PERSONAL.

MR. A. J. DE B. CORRINEAU, of the Montreal & Southern Counties Railway Company, Montreal, Quebec, is in New York, investigating the merits of the various types of automobiles now on the market. It is his intention to introduce automobiles in Montreal.

MR. FRED A. GEIER, secretary and treasurer of the Cincinnati Milling Machine Company, and Mr. H. C. Hoefinghoff, president and general manager of the Bickford Drill & Tool Company, of Cincinnati, Ohio, sailed for Europe Tuesday, April 24. They report the foreign and domestic business of their respective companies in extremely satisfactory condition, with a bright outlook for the near future.

ADELBERT KURZ, a prominent machinery manufacturer, of Vienna, Austria, in company with his chief engineer, Belka Ruppos, was in Cleveland several days recently, visiting machinery manufacturers.

MR. PAUL H. BRANGS has resigned as electrical engineer of the Lackawanna Railroad and accepted a position with the Safety Car Heating & Lighting Co. (Pintsch system), with offices at 160 Broadway, New York. Mr. Brangs, who had been ten years with the Lackawanna company, was one of the pioneers in the electrical field, having been with Maxim in 1880, and was with the United States Company previous to entering upon railroad signaling work.

EDUCATIONAL.

ROSE POLYTECHNIC INSTITUTE.—The eighteenth annual catalogue of the Rose Polytechnic Institute, of Terre Haute, Ind., for 1900, gives an outline of the courses of study and plan of instruction. It contains 104 pages, and at the back is given a list of the names of the alumni of the institute with their addresses and business connections.

LAFAYETTE COLLEGE.—We are in receipt of a copy of the catalogue of Lafayette College, Easton, Pa., for 1899-1900. The catalogue contains 142 pages, and gives the usual information regarding admission, studies, etc. At the back is given an alphabetical list of the names of the students. This college has a scientific department, which includes an electrical engineering course.

MR. JOSEPH W. HARRIS lectured before the Mechanical Engineers' Club of the University of Pennsylvania on Thursday, April 12. The process of making incandescent lamps and lamp filaments was described in detail and experiments were made showing the actual method of firing the filaments, of testing the vacuum by means of an induction coil, and of measuring the current flowing from one side of the filament to the other through the nearly perfect vacuum.

RAILWAY MOTOR ENGINEERING is a new course of correspondence instruction offered by the International Correspondence Schools, Scranton, Pa. The course was prepared and is being kept up to date by Eugene C. Parham, superintendent of the Nassau division of the Brooklyn Rapid Transit. It is intended for operators and those who wish to become operators of electrical machinery, and contains practical instruction on the operation and maintenance of electric cars and motors.

Trade Notes.

THE LAWTON-BEATTIE ELECTRIC COMPANY, of Cincinnati, will install several of the latest pattern electric fans in the Business Men's Club, of that city.

HARE'S COMMUTATOR COMPOUND.—Messrs. Southworth & Hare, Indianapolis, Ind., have appointed L. J. Osborne, 1200 Fisher Building, Chicago, their Western agent, and F. E. Ross, 235 Greenwich Street, New York, their Eastern agent.

THE STANDARD UNDERGROUND CABLE COMPANY announces the removal of its New York offices, April 30, to more commodious quarters at 56 Liberty Street (corner Nassau), and at the new location will be glad to welcome its customers and friends.

THE VULCAN FOUNDRY COMPANY, Cincinnati, Ohio, has been reorganized and Mr. Eugene K. Frintz, of that city, has been taken in as a working partner. Mr. Frintz is the new superintendent. The company will devote its energies principally to the manufacture of machine tool castings.

THE OSBURN ELECTRIC MANUFACTURING COMPANY, of 294 Dearborn Street, Chicago, will hereafter be known as the Electric Supply Company. The business in the future will be under the personal control of Louis W. Jones, who was formerly treasurer and later president of the Osburn company.

OYSTER ROAST.—The Berlin Iron Bridge Company is sending to its friends an invitation to the annual oyster roast to be given to its employees and families on the evening of April 27, at East Berlin, Conn. The design of the invitation card is happily conceived and its execution a credit to the engraver and printer.

THE ELECTRIC MACHINERY COMPANY, of Minneapolis, Minn., has installed one of its new 100-kw direct current generators in the court house. It is direct connected to a 175-hp, simple American Ball engine. The company has recently added a 12-foot Pond boring mill and a 10-foot half universal radial drill to its shop equipment.

THE CROCKER-WHEELER COMPANY, in order to handle its increasing business, has just established its headquarters and general offices at its works at Ampere, N. J. Business in the metropolitan district and vicinity will be conducted as usual from its New York office, 39 and 41 Cortlandt Street, under the management of Mr. F. S. Blackall.

THE AMERICAN ELECTRICAL HEATER COMPANY, of Detroit, Mich. has been compelled, on account of large increase in business, to move into larger quarters. It is now to be found at 195 and 197 River Street. This company has always been noted for its promptness in filling orders, and with its increased facilities can now execute all orders with its oldtime despatch.

SEPARATOR SATISFACTION.—The A. A. Griffing Iron Company, 66 Center Street, New York, has issued a neat illustrated pamphlet, telling what Bundy steam and oil separators do. Various testimonials show the satisfactory results obtained by the use of these separators. Steam users should look into the merits of these devices, if they are not already familiar with them.

SECOND-HAND ELECTRICAL SUPPLIES.—In a new catalogue the Chicago House-Wrecking Company, West Thirty-fifth and Iron streets, Chicago, lists many varieties of electrical supplies, fan motors, etc., obtained from dismantled buildings and particularly from the late Omaha Exposition buildings. According to a newspaper despatch, this house has been awarded the contract for dismantling the Paris Exposition.

ELECTRICALLY DRIVEN DRILLS.—The Stow Manufacturing Company, Binghampton, N. Y., in a new catalogue, shows a number of applications of the electric motor to flexible drill work. The motor manufactured by this company is particularly applicable to this work, admitting of economical speed regulation between wide limits. A number of forms of the motor is shown, both for machine and general power work.

WARNER ELECTRIC ELEVATORS.—The New York branch of the Warner Elevator Manufacturing Company has called to that city Mr. J. W. Atkins, prominently identified with the Cincinnati headquarters of that concern. The New York branch has worked up a large business in the electric elevators, of which line the Cincinnati house is one of the pioneers. There are now in process of construction at the Cincinnati headquarters several elevators for New York buildings.

ASHCROFT STEAM SPECIALTIES.—The Ashcroft Manufacturing Company, 85 Liberty Street, New York, has recently issued a 164-page catalogue, in which are illustrated and described a varied line of high grade steam specialties and articles manufactured by it. Among these products may be mentioned the Ashcroft pressure guage, the Edson pressure-recording and alarm gauge, the Mosscrop speed recorder, etc. The catalogue is substantially bound, and is 6¼ by 9¼ ins. in size.

STEPHENSON BAR BELT DRESSING.—The Stephenson Manufacturing Company, Albany, N. Y., manufactures a belt dressing that is giving much satisfaction to those who are using it. It is made in the form of a round bar, of convenient length, and is easily applied. The stick is the most economical form and is always ready for immediate use. The testimonial letters received by the company from users of this dressing speak very highly of it. It is stated that there are thousands of pleased customers throughout the country.

MESSRS. EUGENE MUNSELL & CO., 218 Water Street, New York, and 117 Lake Street, Chicago, report a very gratifying demand for their India and amber "Mica." They make a specialty of stamping "Mica" segments and washers and also carry a large stock of cut sizes, ready for immediate shipment. The company's product is well known for its high insulating qualities throughout America and Europe. Street railway companies and electrical manufacturers and repair companies will do well to investigate the merits of these goods.

WILLIAM ROCHE, 42 Vesey Street, New York, manufacturer of the New Standard dry battery, has two cells of this battery in the government building at the Paris Exposition. These cells, when sent to the stores for packing and shipping on Jan. 30, measured on short circuit 1.54 volts and 22 amperes. The Navy Department has since then raised the standard of requirements from 1.47 to 1.50 volts, and also stipulates the New Standard. Mr. Roche's split-post connector, patented last year, is growing in popularity. With its use the slipping of wires is said to be impossible. Some large telephone operators are using them.

THE WHEELER REFLECTOR COMPANY, the well known manufacturers of reflectors and shades, will, about May 1, remove to its new and larger office and factory at 100 Purchase Street, corner of Oliver Street, Boston. Gen. Elbert Wheeler, who for the past 20 years has been treasurer and manager of the company, will hereafter devote his time to his other interests (though still retaining the position of treasurer of the Wheeler Reflector Company), and will have his office at 14 Beacon Street. Mr. H. C. Hawks, well known to the electrical trade has accepted the position of general manager, and will have the active management of the company.

MR. VINCENT GRAY, of New Orleans, was in New York City this week. Mr. Gray is the manufacturer of the auto-rotary hand fan. During his stay in the city, arrangements were made with J H. Bunnell & Co. to handle these fans as distributing agents in the East. The fan, as its name implies, is held in the hand, but, instead of the old-fashioned calisthenic exercises needed to obtain a breeze, all that is necessary is to press the handles together occasionally to set going a rotary fan with a speed of 2800 revolutions a minute, thus securing the desired cool air without making any exertion. There will be a large field for such a fan in hospitals and sick rooms; its weight is less than 5 ounces; it is very neat in appearance, can be folded up and put in the pocket.

THE WILHELM TELEPHONE COMPANY OF PENNSYLVANIA, 1011 Chestnut Street, Philadelphia, has completed the installation of its double diaphragm telephone transmitters in the following named large manufacturing plants in that city: Fulton & Walker Company, Otto Gas Engine Works, S. Rosineau, the Edgel Company, North Bros. Mfg. Co., H. W. Buterworth Sons' Company, Berkshire Manufacturing Company, Frankford, Pa.; Bement Miles & Co., Beswick & Kay, Dungan, Hood & Co., and the Vulcanite Cement Works, Vulcanite, N. J. Messrs. Coon & Moreau, proprietors of this telephone, have now several large contracts on hand to be completed. They are delayed in their work by the cable manufacturers, who are said to be from four to six weeks behind in their orders.

THE WESTERN ELECTRIC COMPANY has issued some neat and comprehensive bulletins on fan motors. Bulletin 23-F describes in detail the various styles and sizes of direct current desk and bracket motors. Bulletin 24-F contains information and a complete description of the standard ceiling fans for direct current. Bulletin 25-F describes the Arctic ceiling fan motors and wall switch rheostats. Bulletin 26-F describes the Tuerk alternating ceiling fans and alternating desk and bracket fans. All of these bulletins give code words and list numbers. The Western Electric Company manufactures over 200 different styles and sizes of fan motors, and can supply the same for 110, 170, 220, 250 and 500 volts for direct current, and can supply alternating current motors for 52, 104, 110, 220 volts, and for 60, 125, 133, 140 cycles.

THE CONSUMERS' CARBON COMPANY.—Mr. Edmund Dickey, former General Manager of the American Carbon Company, is now connected with the Consumers' Carbon Company, of Lancaster, Ohio, in the same capacity. The company referred to has recently been incorporated for the purpose of manufacturing and dealing in electric light carbons, and also battery and electrolytic carbons, motor and dynamo carbon brushes and carbon products generally. The factory is located in natural gas territory, and as the company owns its gas wells, fuel is obtained practically without cost. As fuel is one of the important items in the cost of carbon, amounting to about 75 cents per 1000, the advantage just noted is obvious. The capacity of the factory will be 150,000 carbons per day and will employ about 160 men. It will be in full operation in time to supply the fall trade.

BULLOCK GENERATOR FOR PARIS EXPOSITION.—A handsome 200-kw Bullock generator and switchboard were shipped from Cincinnati on April 24, to be established in the Vincennes section of the Paris Exposition. This is a duplicate shipment. The original left Cincinnati about two months ago consigned by the Bullock Electric Manufacturing Company and was shipped on the lost steamer Pauillac. Just 24 days have elapsed since the duplicate order was received from Paris. The generator is expected to be in New York by May 1, and it should be installed in the Vincennes section by the last wek in May. All possible haste will be employed, as upon the generator depends all the power to be used in the entire Vincennes section. A cable order just received by the Bullock company from its Paris agent, "Societe l'Electra" calls for a 400-kw belted generator to furnish power for an electric street railway in one of the cities of France Shipment will be made some time in August.

Record of Electrical Patents.

UNITED STATES PATENTS, ISSUED APRIL 17, 1899.

[Conducted by William A. Rosenbaum, Patent Attorney, 177 Times Bldg., N. Y.]

647,456. AUTOMATIC MAXIMAL SWITCH FOR ELECTRIC POWER AND LIGHTING CURRENT; T. Allemann, Olten, Switzerland. App. filed Dec. 4, 1899. With this apparatus the current is automatically cut off from a consumer's circuit whenever he is using more than he has contracted for. The invention consists of the details of construction.

647,471. CABLE JOINT; W. M. Brown and G. H. McFeaters, Johnstown, Pa. App. filed Aug. 23, 1899. Instead of the usual "wiped" joint for lead-covered cables, this joint is made by a lead sleeve, which is connected with the main sections by fusing its ends thereto.

647,492. ELECTROMAGNETIC SWITCH ARRANGEMENT; T. Hoffmann, Charlottenburg, Germany. App. filed Dec. 5, 1899. This is a switch for turning gas on and off, either by hand or, automatically, in case the hand arrangement fails. A partial hand manipulation closes a circuit, which heats a resistance wire, which in time will expand mercury and close a contact which has not been closed by the hand operation.

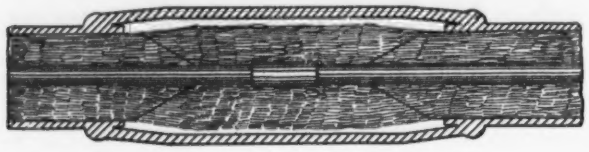
647,536. ZINC SUPPORT FOR BATTERIES; S. E. Smith, Beloit, Wis. App. filed April 17, 1899. The support is a bar adapted to rest on top of the jar, and is of such form that when the zinc is supported from one side of it, it will be sustained at a certain level, while if the other side is used, the zinc will be held at a different level.

647,565. ELECTRIC THERMOSTAT FOR FIRE ALARM; H. V. Hayes and G. K. Thompson, Malden, Mass. App. filed Aug. 10, 1899. The thermostat is in cable form, two wires of the cable being insulated from a piece of fusible metal by a network of non-conducting material; when the fuse melts it flows through the network and connects the two wires.

647,570. RAILWAY SIGNALING APPARATUS; F. A. Landee, Moline, Ill. App. filed July 10, 1899. Details of construction of a crossing signal.

647,584. INDUCTOR ALTERNATOR; S. H. Short, Cleveland, Ohio. App. filed Sept. 1, 1898. (See Current News and Notes.)

647,585. MEANS FOR BALANCING MULTIPOLAR ELECTRIC MACHINES; S. H. Short, Cleveland, Ohio. App. filed Nov. 2, 1898. (See Current News and Notes.)



647,471.—Cable Joint.

647,588. COMBINED TELEPHONE AND ELECTRO-THERMOSTATIC FIRE ALARM SYSTEM; G. K. Thompson, Malden, Mass. App. filed ——5, 1899. A fuse similar to that described in patent 647,565 is inserted in parallel to the instruments at a subscriber's station and when actuated sends an ralam to the central office.

647,589. INDUCTION COIL; R. Varley, Jersey City, N. J. App. filed Feb. 21, 1900. This is a casing for induction coils, so constructed that the primary, secondary and core can be removed easily and at will. Surrounding the iron core is a tube of insulating material closed at one end by a flanged head; a primary coil is placed on said tube, a secondary coil is placed around the primary coil and an exterior cylinder closed at one end and enclosing the flanged head of the tube and fastening devices for connecting the exterior cylinder with the central tube.

647,614. ELECTRIC FURNACE; M. Ruthenburg, Philadelphia, Pa. App. filed Nov. 22, 1899. For continuous operation, the furnace is open above and below, so that the material can be passed into the top and fed between the electrodes and thence out through the bottom.

647,617. ELECTRIC GAS LIGHTING DEVICE; G. Schuenemann and O. Rieder, Buda-Pesth, Hungary. App. filed April 29, 1899. Details of construction.

647,624. TROLLEY FORK; E. Eddy, New York, N. Y. App. filed Aug. 9 1899. Above the wheel, extensions of the fork carry inwardly turned cheeks which are pressed inward to obstruct the outward passage of the wire. These cheeks are held by springs, which yield when it is desired to remove the trolley from the wire.

647,634. ELECTRIC LIGHTING APPARATUS FOR RAILWAY CARS; W F. Richards, Buffalo, N. Y. App. filed Jan. 19, 1900. This is a belt-tightening arrangement, in which the gravity action of the dynamo is supplemented by an adjustable spring.

647,647. ELECTRIC INSOLE FOR SHOES; H. O. Candee, Syracuse, N. Y. App. filed Aug. 30, 1899. The flexible insole is provided at the middle with

647,565.—Electric Thermostat for Fire Alarms.

two plates fastened, one upon the other, the under plate being longer, so as to receive a line of stitching to hold the plate in position.

647,687. ELECTRO-THERAPEUTIC DEVICE; T. W. Topham, New York, N. Y. App. filed Dec. 19, 1899. With this device, it is designed to place the patient under the influence of electric and light currents of various kinds and intensities; also to create a blast of air charged with ozone by means of electric sparks, and to provide means whereby the patient is enabled to breathe the air.

647,691. ELECTRIC ARC LAMPS; J. T. Beswick, New York, N. Y. App. filed Feb. 6, 1900. A clutch comprising a body having an opening through which the carbon passes, a second opening at an angle to the first and a gravity-acting pin provided with an enlarged head which, when the clutch body is lifted, will impinge upon the carbon.

647,694. ELECTRIC METAL WORKING APPARATUS; G. D. Burton, Boston, Mass. App. filed Aug. 11, 1898. One of the electrodes is supported on an anvil, while the other swings at the end of an arm.

647,716. METHOD OF REGULATING ELECTRIC MACHINES; W. H. Cooley, Brockport, N. Y. App. filed Dec. 28, 1899. A method of regulating the potential at the terminals of a translating device, which consists in generating a series of practically constant electromotive forces between the terminals of the supply circuit, together practically equal to the potential between such terminals and generating such electromotive forces variously in series and in parallel with such translating device, and varying the total electromotive force generated in series with such translating device inversely with the total electromotive force generated in parallel with such translating devices.

647,723. AUTOMATIC DAMPER REGULATOR; J. T. Luton, Evansville, Ind. App. filed Oct. 10, 1899. An electric motor geared to the damper is controlled by a thermostat.

647,729. APPARATUS FOR RECORDING MORSE TELEGRAPHIC CHARACTERS; C. Stevens, C. C. Vyle and W. Miller, London, Eng. App. filed Nov. 13, 1899. This is a peculiar construction of punch and mechanism for operating it, for punching the dots and dashes of the Morse system in a tape.

647,741. SYSTEM OF ELECTRICAL TRANSMISSION; F. Bedell, Ithaca N. Y. App. filed Jan. 31, 1900. (See Current News and Notes.)

647,743. ELECTRIC MOTOR CONTROLLER; H. Cochrane, Chicago, Ill. App. filed June 15, 1899. The machine is compound wound and arranged to be run as a motor or generator; the connections of the series field winding are automatically reversed when the machine runs as a generator.

647,748. PLOUGH FOR CONDUIT ELECTRIC CARS; J. B. Gootsberger, New York, N. Y. App. filed Jan. 4, 1900. The plough is equipped with an upper and a lower set of shoes, either of which may be thrown into operative position while the plough is in use.

647,752. STORAGE BATTERY ELECTRODE; R. Macrae, Baltimore, Md App. filed April 24, 1899. (See Current News and Notes.)

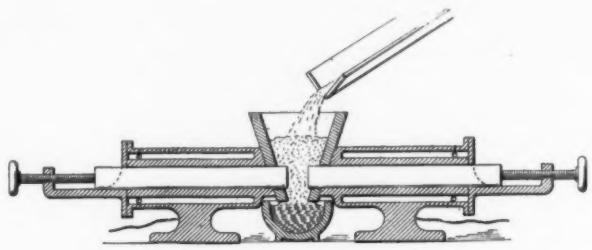
647,753 and 647,754. STORAGE BATTERY ELECTRODE; R. Macrae, Philadelphia, Pa. Apps. filed Nov. 17, 1899. (See Current News and Notes.)

647,783. SWITCH APPARATUS FOR ELECTRIC CURRENT DISTRIBUTING CIRCUITS; T. Allemann, Olten, Switzerland. App. filed Nov. 2 1899. This is a time switch, the invention consisting in the details of construction.

647,797. GALVANIC BATTERY; H. Blumenberg, Jr., and F. C. Overbury, New York, N. Y. App. filed April 24, 1899. In a two-fluid battery, a cup for holding the crystals in the lower part of the cell is suspended by supports fastened to the cover of the cell.

647,829. ELECTRIC SWITCH; J. I. Gunther, New York, N. Y. App. filed Oct. 4, 1899. A switch barrel of insulating material carries two contacts and is rotated by means of a push-button which engages with a ratchet wheel on the end of the barrel.

647,839. TROLLEY WHEEL; C. S. Johnson, East Liverpool, Ohio. App. filed Jan. 24, 1900. The wheel is constructed in separable parts, so that when



647,614.—Electric Furnace.

one portion has become worn it may be removed and substituted by a new portion.

647,858. PROCESS OF OBTAINING PERMANENT DEPOSITS OF METALS ON ALUMINUM; E. Mies, Buedesheim, Germany. App. filed Sept. 9, 1899. (See Current News and Notes.)

647,874. ELECTRIC ARC LAMP; C. A. Pfluger, Chicago, Ill. App. filed Aug. 7, 1895. An accelerating device is associated with the regulating magnet to hasten the action of the clutch at the moment of feeding, to a degree beyond that resulting from the normal increase of current flowing in the magnet.

647,924. PULLEY FOR OVERHEAD TELEPHONE CABLE; W. H. Kennedy, Akron, Ohio. App. filed March 7, 1900. This is a skeleton block, the casing of which can be opened to admit the cable and then closed to hold the cable on the pulley.

GERMAN PATENTS, ISSUED APRIL 4, 1900.

[In Charge of Dr. Ralph Julian Sachers, 120 Liberty Street, New York.]

108,175. DIRECT-CURRENT MOTOR; Hugo Wolf, Dresden, and Wilhelm Brase, Berlin. App. filed March 19, 1899. The armature is stationary and the commutator brushes are rotatable. The poles brought into rotation in the armature will carry along the rotatable field magnet, and the speed of the field magnet may be regulated by simply changing the speed of the commutator brushes without interrupting or decreasing the actuating current.

108,265. METHOD OF STARTING ELECTROMOTORS; James Burke, Berlin. App. filed Sept. 7, 1898. The armature of the motor is first supplied with a current of low tension but large quantity, until the motor is in motion; thereafter the regular current of higher tension and lower quantity is successively supplied through an adjustable resistance whereby the auxiliary current circuit becomes inactive and may finally be cut off by hand or automatically.

108,369. DEVICE FOR THE PREVENTION OF PHASE SHIFTING BETWEEN CURRENT AND TENSION IN ALTERNATING CURRENT WORK; Moritz Heinrich Boeninger, Cologne. App. filed June 22, 1898. An auxiliary e. m. f. is produced in a separate dynamo and connected in series to the main e. m. f. This auxiliary e. m. f. is directly opposite in location to the e. m. f. producing the phase displacement, and is only influenced, independent of amperage and voltage, by the phase shifting between current and tension. This may be done by hand or an automatic device, which operates as soon as phase shifting takes place.

108,398. DEVICE FOR THE PREVENTION OF SPARKING; Moritz Heinrich Boeninger, Cologne. App. filed April 13, 1898. In place of the usual switch a semi-conductor is placed in the circuit, which carries the current when heated, but is a non-conductor when cold. In order to turn on the current a source of heat is applied until the current passes. For turning off the current, the semi-conductor is cooled off.

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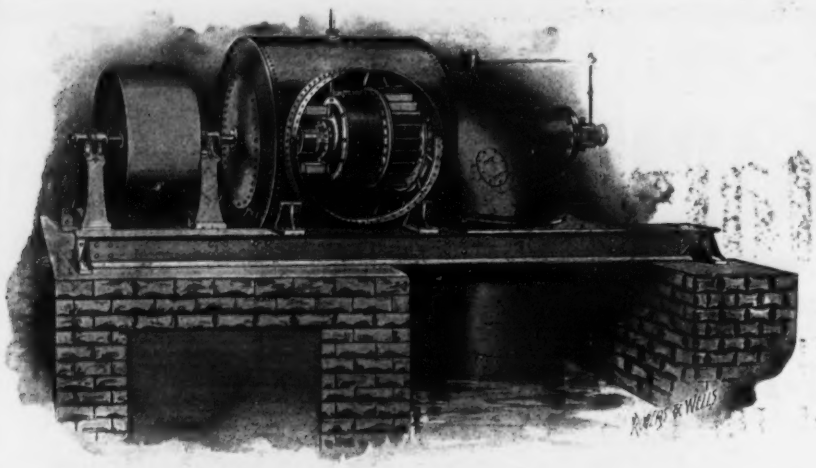

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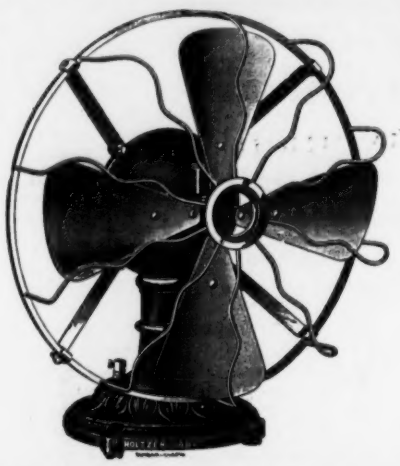

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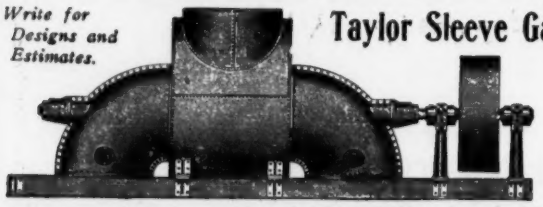

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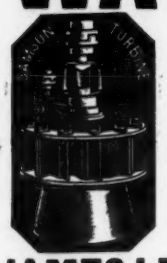

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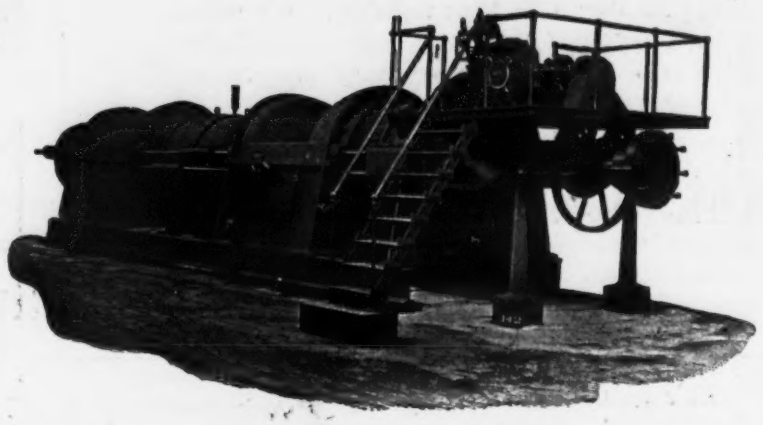

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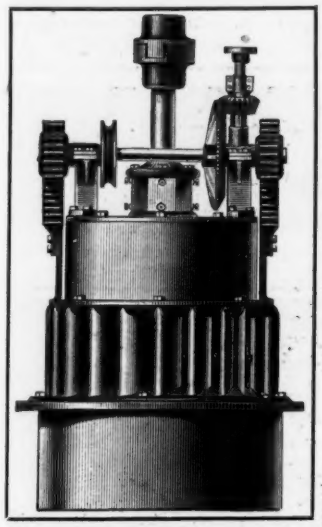

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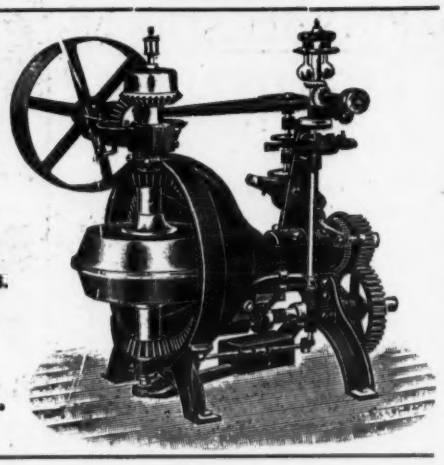

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